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GAS AND THE A-BOMB

PIPELINE EXPANSION STUDY

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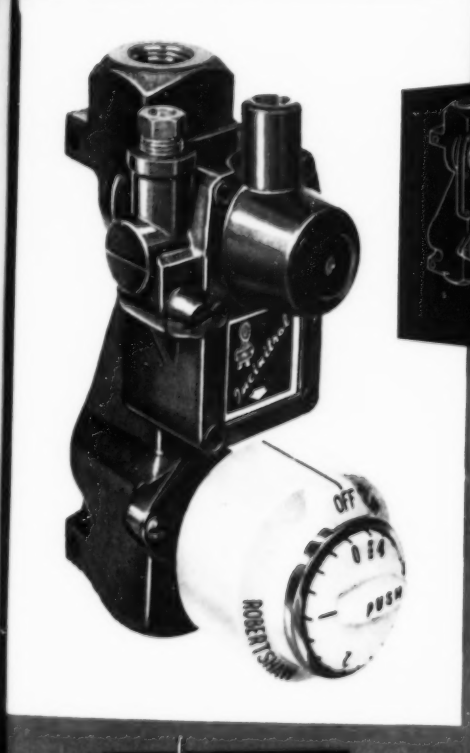
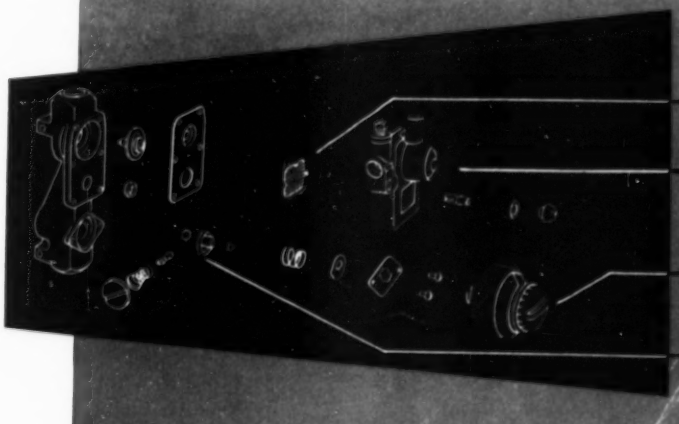
ANNOUNCING... Robertshaw®-Grayson

*Incinitrol**

combination control for automatic gas-fired incinerators





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Thermo-magnetic pilot for complete automatic shut-off

Automatic timer (0 to 4 hours)

Gas cock

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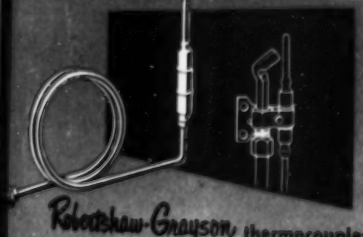

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Robertshaw-Fulton CONTROLS COMPANY

Robertshaw Thermostat Division, Youngwood, Pennsylvania

Robertshaw-Fulton Controls (Canada) Ltd., Toronto

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INCORPORATED (ESTABLISHED 1836)

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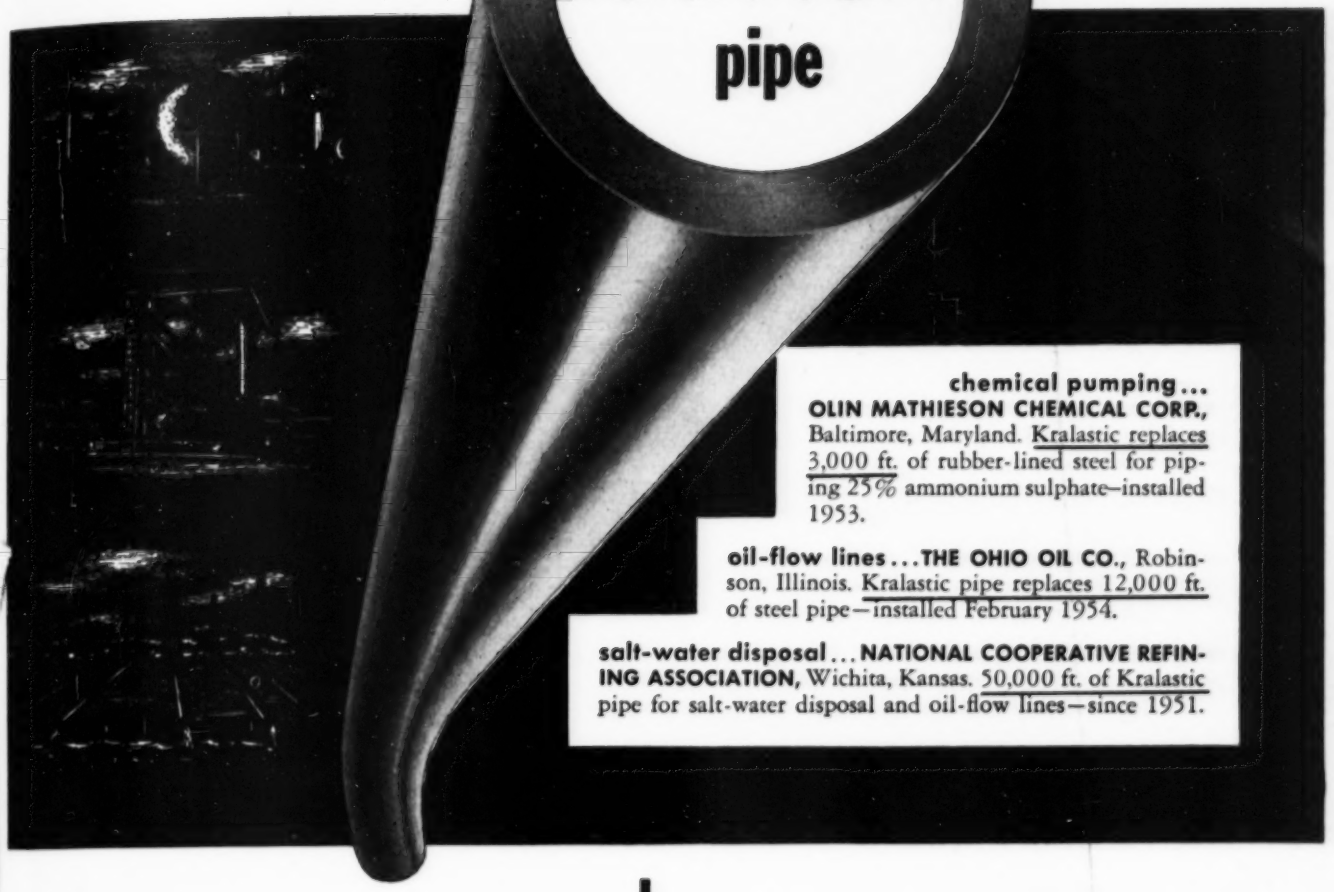

chemical pumping... OLIN MATHIESON CHEMICAL CORP., Baltimore, Maryland. Kralastic replaces 3,000 ft. of rubber-lined steel for piping 25% ammonium sulphate–installed 1953.

oil-flow lines... THE OHIO OIL CO., Robinson, Illinois. Kralastic pipe replaces 12,000 ft. of steel pipe—installed February 1954.

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A unique combination of plastic and elastomeric materials, Kralastic offers superior physical properties that no other pipe material can match. The resin-rubber blend makes Kralastic *hard, tough,* and resistant to most chemicals. It also gives Kralastic extremely high impact strength—even at Arctic temperatures. The butadiene type rubber used is oil and chemical resistant.

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GAS

31ST YEAR OF PUBLICATION

IN THIS ISSUE . . . .

Gas came through the A-bomb test with flying colors, as did its fellow-fuel, LPG. With power poles snapping like matchsticks, gas meters, tanks, and other equipment stood up well (see page 53-56). . . . Electric appliance manufacturers are working overtime to wipe out gas' advantages in speed, flexibility, and economy. Reports of "spies" appear on pages 50, 62, and 63. . . .

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GAS is published monthly by Jenkins Publications, Inc., 198 South Alvarado Street, Los Angeles 57, California. Subscription price: United States and possessions and Canada (in advance): $1.00 per copy; one year, $2.00; two years, $3.00. Mexico, South and Central America, Caribbean Area: one year, $3.00; two years, $5.00. All other countries: $10 per year.

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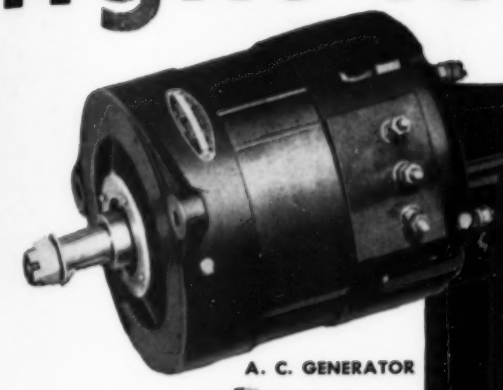
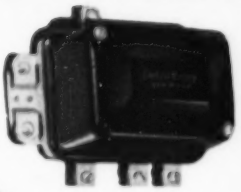
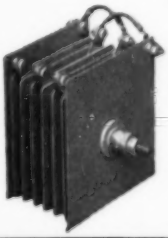
right for the job



A. C. GENERATOR

REGULATOR





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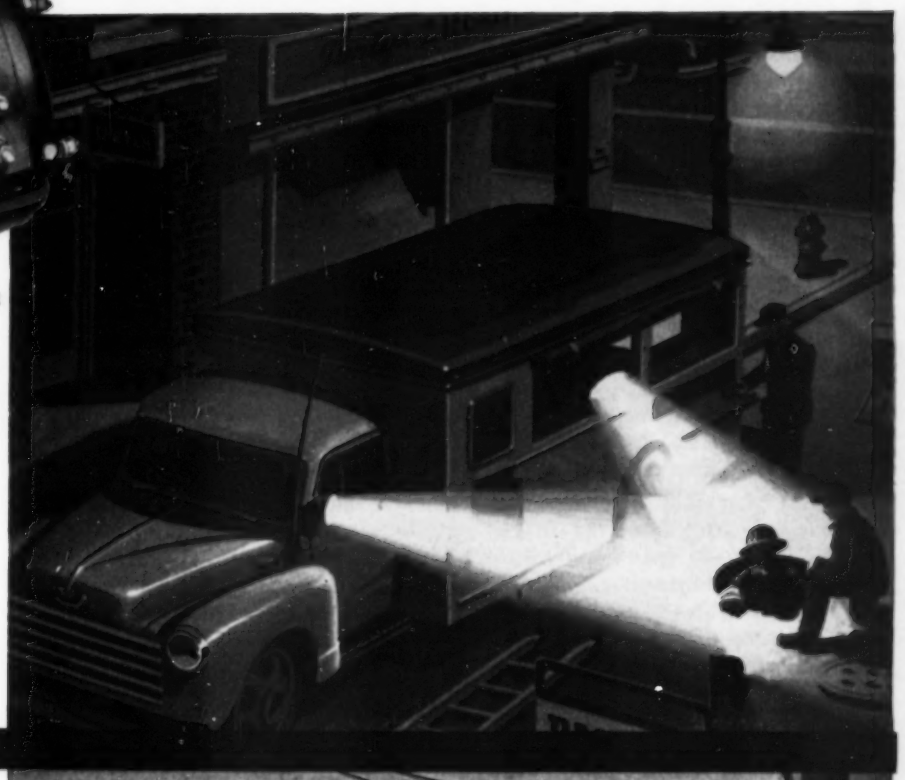

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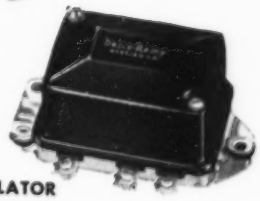

REGULATOR

A GENERAL MOTORS PRODUCT — A UNITED MOTORS LINE

DISTRIBUTED BY WHOLESALERS EVERYWHERE

GAS Thermally Thinking

"S" stands for "sales"

THE AGA has a new managing director, and as with any change of administration, the natural question that pops into mind is, "What will this mean to the industry?" It may mean little, of course, because this was no "throw the rascals out" affair; the orderly, efficient, and effective administration of Carl Wolf was terminated by ill health, and the succession of C. S. Stackpole to the head man's chair is merely the substitution of one capable man for another. Were Carl Wolf able, there is no doubt that he would have retained his post for as long as he might want it.

But why Chet Stackpole?

Carl Wolf was a utility company (Atlanta Gas Light Co.) president when he was picked to succeed Maj. Alexander Forward just 10 years ago. Major Forward was a newspaperman and public servant, having been among other things a member of the Virginia State Corporation Commission, when he was tagged for the job in 1923. True, Carl Wolf came to the AGA as a strongly promotion- and advertising-minded utilities executive, and the record of development of such programs as PAR through the past decade speaks for itself. But he did not come to the association as a salesman, as such; he came as an executive.

Chester Stackpole, on the other hand, has spent virtually all his adult life in selling. From the time he joined Stone & Webster in 1922 through his years with Baltimore Gas & Electric to his career with various appliance manufacturers, he has always been cast in the role of a salesman. Never a utilities president, he was nevertheless manager of merchandising, sales promotion, and domestic gas and electricity sales for Baltimore Gas. He held sales vice presidencies in two of the appliance manufacturing companies with whom he was associated in later years.

At this point we suddenly find ourselves wondering which is cause and which is, or will be, effect. Did the AGA board of directors purposely hire a salesman because a sales job is needed? Or is it coincidental; and since a salesman is in the driver's seat, will new emphasis be placed upon sales? Which, in other words, came first?

And is it only coincidental that Chet Stackpole has served both utilities *and* manufacturers?

The post is, of course, primarily administrative. Basic policy is made by the membership through its elected officials. But the direction in which this policy is carried out is the responsibility of the administrator; his knowledge, bent, and convictions cannot help but play their part in shaping the course of future progress in the association.

Regardless of whether the choice was based upon any such considerations, the new managing director has our heartiest congratulations, if not our complete and unalloyed envy.

The industry is still in many ways a patchwork of pieces. Producer, pipeliner, utility, and appliance manufacturer have still not resolved many of their basic differences. This disunity is certainly evidenced in the sales lag. At the moment, appliance sales are in an ascension; but general business activity, which is continuing to rise, is no doubt a factor—particularly in the new housing field. The rate of appliance sales still falls short of the gains on general gas usage. GID progresses, but at no breathtaking pace; and it was late getting off the ground. The electric industry, bigger and more unified, is nipping at all the domestic loads—even water heating and heating, which *shouldn't* be vulnerable, but are, according to current reports (see pages 50-52 in this issue).

Chester Stackpole is faced with many challenges. May he face them with the optimism and fervor of a true salesman. And may it not be mere coincidence that S, which stands for sales, also stands for Stackpole.

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This great natural gas transmitter establishes *conclusively* the value of what it sells . . . with C-H Calorimeters.

C-H B.t.u. Control Equipment used on this system

El Paso Natural Gas uses Cutler-Hammer Calorimeters at gathering and distribution points to measure the B.t.u. content of the gas gathered and sold.

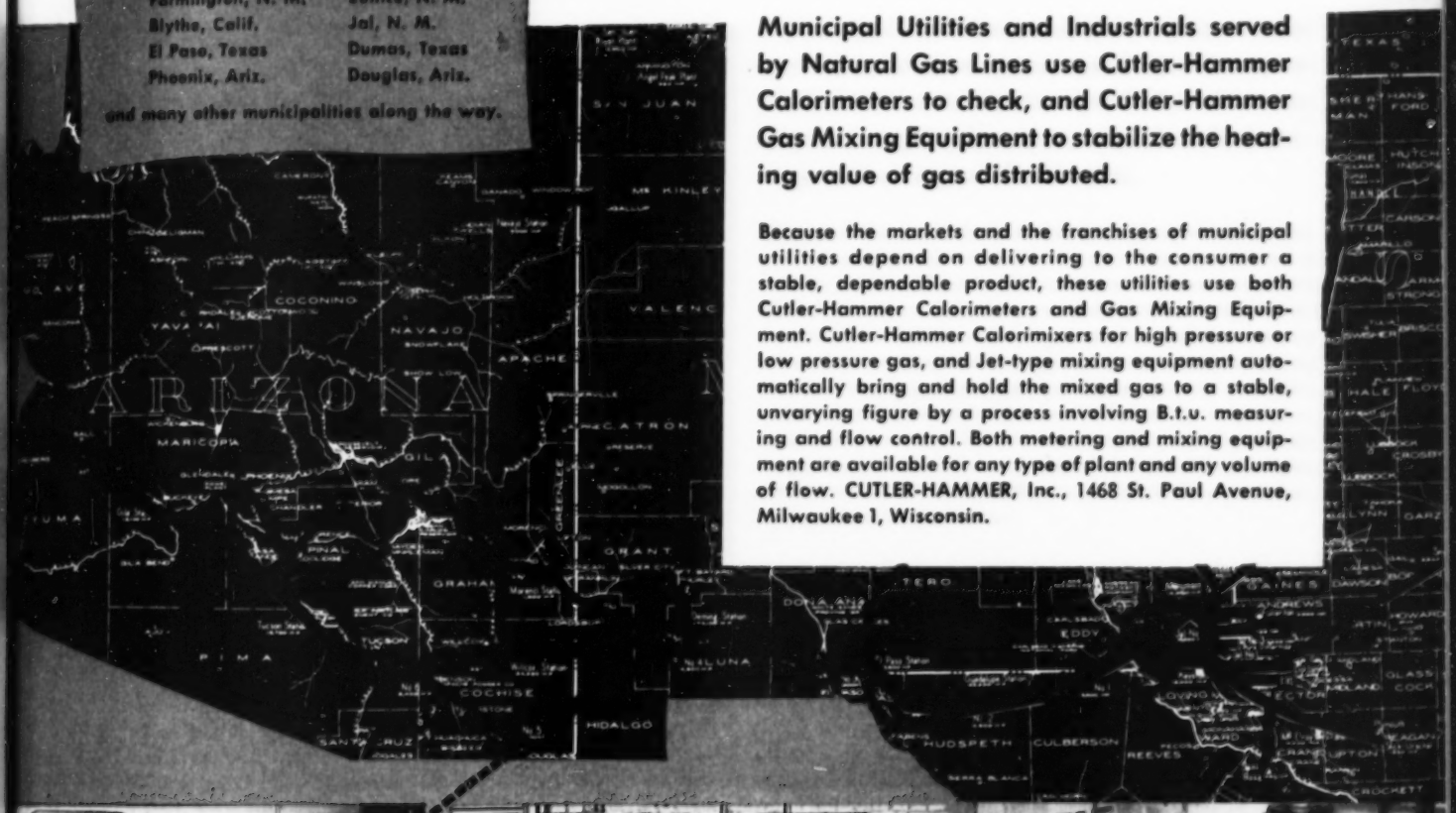
The municipalities served by El Paso Natural Gas use C-H Calorimeters to check the heating value of the gas distributed. Typical C-H installations are found in

Farmington, N. M.	Eunice, N. M.
Blythe, Calif.	Jal, N. M.
El Paso, Texas	Dumas, Texas
Phoenix, Ariz.	Douglas, Ariz.

and many other municipalities along the way.

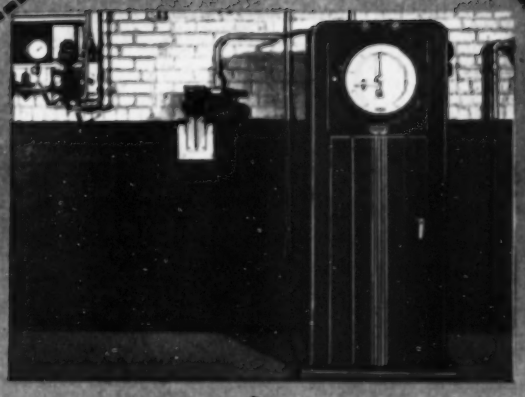
On the basis of known performance the El Paso Natural Gas Company rates as one of the great and progressive natural gas transmitters... acutely sensible of its public responsibility. 5700 miles of pipeline serve 12 million people in 4 states with a daily capacity of more than one billion cubic feet. This vast and far-flung enterprise is based on one simple fact . . . the earning of an adequate return on gas passing through its lines. Since a fair return *must* be in proportion to the heating value of the gas, *NOT* to "count" B.t.u.'s accurately is to be inconsistent toward both rates *and* profits.

And the El Paso Natural Gas Company which does *not* take its public responsibility lightly, *does* use Cutler-Hammer Calorimeters at key points in its system. For the Cutler-Hammer Calorimeter is the *only* instrument that *does* so "*count*" B.t.u.'s accurately, conclusively, dependably, and unceasingly.



Municipal Utilities and Industrials served by Natural Gas Lines use Cutler-Hammer Calorimeters to check, and Cutler-Hammer Gas Mixing Equipment to stabilize the heating value of gas distributed.

Because the markets and the franchises of municipal utilities depend on delivering to the consumer a stable, dependable product, these utilities use both Cutler-Hammer Calorimeters and Gas Mixing Equipment. Cutler-Hammer Calorimixers for high pressure or low pressure gas, and Jet-type mixing equipment automatically bring and hold the mixed gas to a stable, unvarying figure by a process involving B.t.u. measuring and flow control. Both metering and mixing equipment are available for any type of plant and any volume of flow. CUTLER-HAMMER, Inc., 1468 St. Paul Avenue, Milwaukee 1, Wisconsin.



C-H Calorimeters *(at left)* measure accurately and uncompromisingly the B.t.u. content of each standard unit volume of gas distributed regardless of temperature, pressure or flow variables, and write a continuous, available record.

C-H Calorimixers *(in center)* automatically mix two or more high or low pressure gases of variable heating value in any volume, holding the final product undeviatingly to a stipulated figure.

CUTLER-HAMMER
B.t.u. CONTROL
C-H

C-H Jet type mixers *(at right)* automatically mix gases of different heating values to a final low pressure stabilized value. When mixing directly into gas mains as well as into holders, they automatically adjust production to widely varying demands.

highlights

GAS — SPOT NEWS, TRENDS, COMMENT ON GAS INDUSTRY AFFAIRS

Time is running out on amendatory bills

The word from Washington is that chances for passage this session of the Harris-Hinshaw, Fulbright, or any other bills to amend the Natural Gas Act are slimming down to the vanishing point. However, Sen. Lyndon Johnson, Democratic leader from Texas, says that when a bill is reported out by the Commerce Committee it will be put on the legislative calendar and that he'll keep it before the Senate "until a vote is taken." But his prediction that the bill would be ready for a vote in the early part of June did not jibe with the experience of the House committee, where hearings are still going on in mid-May, nearly two months after they started.

A compromise will be necessary

Also, there is every indication that the progress of the bills will grind to a halt on dead center unless a compromise is reached on favored nation and escalator clauses. The testimony of eastern utility men, particularly LeBouef of ConEd and French Robinson of Consolidated Natural Gas Co. (see May GAS, pages 11-12), seemed to establish that fact very clearly. And the House Commerce Committee took what Chairman Priest termed "an informal consensus" and came up with a 17-4 vote in favor of FPC control of these two types of clauses.

Are favored nations clauses becoming "absurdities"?

A case recently heard before FPC has limned the issues bearing on the favored nation clause problem. A single contract for a modest amount of gas at a greatly increased price is threatening to bring about almost a doubling in the field price paid by Transcontinental. At the far end of the line, utilities who purchase from Transco are complaining bitterly. And the New York PSC, urging FPC to "call a halt to the inequities and absurdities which must inevitably flow from favored nations clauses," avers that Transco "cannot purchase additional supplies in Texas because of the triggering that would result from two-party favored nations clauses."

Relocation reimbursement expected in President's highway bill

The bill for superhighways, S1048, which if approved at all is expected to go through this session, has been reported out of the Senate Public Works Committee. The committee recommended reimbursement for utilities for a portion of relocation costs, a multimillion-dollar item. No House action has been taken as yet, but the bill is due to come up before the parallel committee there in June, and presumably will be reported out before the end of the month. As offered, the bill is actually not the same as the one proposed by the President; it's a substitute written by Senator Gore of Tennessee. Reimbursement would be limited to 25% of the depreciated cost of relocated facilities.

Pacific Northwest is "ready to go"

Fish Northwest Constructors Inc., which is designing and building the big line for Pacific Northwest Pipeline Corp., was poised to kick off clearing and grading of right-of-way late in May. Awards were made to River Construction, R. H. Fulton, Associated Pipeline Contractors, A. J. Curtis, B & M Construction, and Midwestern Constructors for the first eight sections, covering 387 miles of 26-in. and 268 miles of 22-in. pipe between Ignacio, Colo., and Burley, Idaho. Surveying and purchasing of rights of way had already begun when the announcement was made.

California companies signed for more San Juan gas

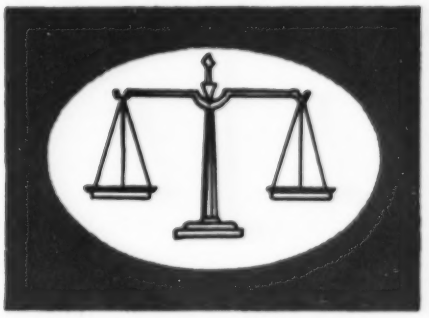
El Paso Natural has agreed to deliver 450 MMcf per day at the California border, with Pacific Gas & Electric Co. taking half and the so-called "Southern companies" the other half. The delivery point would be Topock, where PG&E now accepts deliveries; thus PG&E could loop its present line, but SoCounties and SoCal would be obliged to build a completely new line—which in their case is advantageous. This new proposal ties in with the Westcoast proposal to deliver gas from Canada to the Northwest, but not in exactly the manner previously envisioned: the take-off from the Pacific Northwest line at Mountain Home, Idaho, to the California border at Reno is out. At least, that's what they say (see page 155).

Appliance business continues on uptrend

All domestic gas appliances are continuing to score gains in shipments. Water heaters enjoyed their greatest first quarter in history. Warm air furnaces were 50% ahead of their 1954 performance; ranges have been showing a more modest increase (see page 96) . . . Institute of Boiler & Radiator Manufacturers say first-quarter sales of boilers for househeating were 43.6% ahead of 1954.

*regulatory and legislative trends

Should private radio facilities and maintenance be independent?



GAS companies and other Federal Communications Commission radio licensees in the safety and special radio services classifications are now involved in a controversy over whether it is better to own, operate and maintain a private mobile radio system, or to have a contractor own and maintain the system for operation by the private licensee. The debate contains the most static when a common carrier seeks to provide radio service on a frequency controlled and operated by a private user such as a utility.

The wide use of two-way mobile radio is confirmed by the fact that more than 20,000 licensees operated over 434,000 transmitters in the Industrial, Land Transportation, and Public Safety Radio Services alone during 1954.

Gas company managements will be presented the opportunity to enter radio lease-maintenance arrangements with contractors like the Bell System, Motorola, Radio Corp. of America, and General Electric, so a review of this subject will be helpful.

For self sufficiency of private radio licensees

In 1954 the communications committee of the operating section of the American Gas Association passed a resolution opposing lease-maintenance arrangements for radio communications provided by common carriers on private frequencies. The relevant parts of that resolution are:

"WHEREAS, the gas industry has invested millions of dollars in the development of radio communications systems to perform vital functions in the discovery, production, and transportation and distribution of gas and, therefore, now has a vastly important stake in private radio communications;" * * *

"WHEREAS, it now appears that the common carriers are actively engaged in a studied plan to include the frequencies allocated to private services by the Federal Communications Commission by inducing private users to lease radio communications equipment and maintenance service from common carriers employing private frequencies, thereby promoting a plan which would be used to indicate to the Federal Communications Commission that the private services should be abolished or their frequency allocation curtailed on the theory that their function could be handled by common carriers; and

"WHEREAS, the common carriers could urge this plan on the Commission by pointing to the fact that private users were employing common carrier equipment and service rather than their own on the private frequencies;

"NOW THEREFORE, BE IT RESOLVED that the communications committee of the American Gas Association vigorously opposes the leasing of radio communication equipment maintenance services provided by communications common carriers on private frequencies assigned by the Federal Communications Commission to the Petroleum and Power Radio Service.

"AND BE IT FURTHER RESOLVED that the gas industry make known to the common carriers themselves and to all other interested parties the facts in relation to this position and the reasons why it is essential to the gas industry's continued operations that a system of private communications, as presently established, be continued and maintained in those vital and special areas in which common carriers cannot possibly provide the specialized services required by this industry."

The management of the largest natural gas distributing companies in the United States disagree with the AGA communications committee because they have entered lease-maintenance agreements with contractors for radio facilities and maintenance service on private frequencies which have been assigned to the gas companies by the FCC.

The Bell System position on private radio

As an answer to statements like that of the AGA communications committee, the Bell System has made the following public statement concerning its position on the subject of private mobile radio systems:

"The Federal Communications Commission has allocated frequencies for two broad types of mobile radiotelephone facilities—common carrier systems to serve the general public and systems for the private use of individual licensees.

"The Bell Companies, in providing common carrier radio services, have organized engineering, installation and maintenance facilities and skills to fulfill their responsibilities in this field. It is natural that private radio system licensees should want to benefit from these resources and in the public interest that they be able to do so if they wish.

"The provision of such assistance by the Bell Companies does not, in any way, jeopardize the allocation of frequencies for private system users. On the contrary, the availability of leased radio facilities and maintenance encourages eligible users to employ their allocated frequencies. Many users might otherwise be deterred by problems of capital outlay, obsolescence and complex maintenance. Clearly, if these problems are minimized by leasing from common carriers, the wider use of frequencies by eligible licensees is

*A monthly commentary on national and state developments by an expert in the field of utility law.

Should private radio facilities and maintenance be independent?

thereby made possible. Such wider use, in fact, strengthens the present allocation of frequencies to private licensees rather than weakening it as has been claimed by some.

"Where Bell Companies provide equipment and maintenance for private mobile systems to eligible licensees, the licensee has full control and responsibility for his system. This is just as true whether he leases the system from the telephone company or owns it himself and is further assured by contractual arrangements between the licensee and the supplier.

"The Bell Companies' willingness to provide private systems gives eligible users a choice between ownership or leasing—an opportunity to make the right business decision in any situation."

Regulatory commissioners' comments

Federal Communications Commissioner Robert E. Lee told the 1954 convention of the International Municipal Signal Association that, "Free election by the licensee in this area is necessary for compatibility with our free enterprise system." Commissioner Lee urged the IMSA members "... to assure yourselves that the contents of these agreements guarantee your ability to maintain absolute control of your system, its proper operation and maintenance. Own if you like—lease if you wish, but recognition and complete discharge of your responsibilities as licensees are up to you."

Commissioner Robert D. Yeomans of the Washington Public Service Commission told the 1954 convention of the National Association of Railroad and Utilities Commissioners that:

"The licensee has several options in connection with the manner of handling his radio service. He can purchase the required equipment and have it installed and maintained by his own employees, providing he has a properly licensed employee (2nd Class Radio Operator's license) by Federal Communications Commission regulation. He may purchase the equipment, but may elect to hire someone to install it and maintain it. Or he may arrange to have the equipment furnished, installed and maintained for him on a monthly rental basis, either by the telephone company or someone else. Regardless of which of these possibilities is most attractive to him, the licensee is solely responsible for the operation of the radio system and he cannot in any sense delegate control of the frequencies assigned him.

"In my judgment, the role and intent of the telephone industry in the field of radio is to help customers meet their needs in this new communications art as it has in the older art of wire telephony. There is nothing contrary to the interest of users eligible to obtain private system frequencies in having the communications common carriers furnish the facilities required to utilize them since the user retains full control, and the carrier is only a purveyor of equipment and maintenance service."

In a recent decision by the California Public Utilities Commission, the Pacific Telephone & Telegraph Co. was authorized to purchase the radio facilities of the Southern California Gas Co., and its affiliate Southern Counties Gas Co. of California, for $358,000. The commission had found in an initial decision on this transaction that the annual charges for the maintenance of the radio facilities by the telephone company for gas company operation were insufficient by $12,000 a year to cover the entire costs, plus a 7% return on the investment. The gas companies have agreed to pay annual charges of $126,600 to meet the commission's condition. The California commission concluded that the arrangement would be beneficial to the gas companies and their customers, and that the higher annual payment would avoid any burden on the general telephone users, while resulting in a saving to the gas companies.

The evidence before the California commission showed that such radio lease-maintenance arrangements were being utilized by the gas utilities in New York, Philadelphia, and Milwaukee. In addition, it was shown that 65 utilities in the United States have such radio agreements with the Bell System Companies. Seven hundred of the 20,000 private radio licensees in the United States, or 3½%, have lease-maintenance agreements with the Bell System in their utilization of private radio frequencies.

A gas company executive testified before the California commission that the telephone company presented the best competitive bid for the radio business. He described the following benefits to be derived from the gas company's exclusive control and operation of its private radio frequencies under a lease-maintenance agreement:

"(1) The gas companies will be relieved of the investment and hazards of loss which go with ownership and maintenance of the facilities; (2) instead of becoming further involved in a specialty, which is generally outside the gas companies' field, and one which is characterized by almost continuous technological development and change, we can obtain the communication facilities and maintenance needed without diverting attention from highly specialized responsibilities as utilities engaged in the natural gas business;

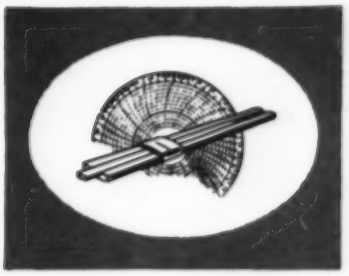
"(3) the telephone company, being expert in communications, will be better situated to keep abreast of the technological improvements in equipment and to incorporate such improvements into the radio system serving the gas companies in the light of broad and continuing experience in the radio field;

"(4) the gas companies will realize annual cost savings, because the charges which will be paid to the telephone company for providing a radio system will be less than the gas companies' annual expenses have been in the past."

The California gas companies' five-year lease-maintenance radio agreement contains many safeguards. The gas companies continue to possess their FCC licenses and assigned radio frequencies. They retain complete control over the physical operation of the radio system and the intelligence transmitted. As an incentive for good service and modern equipment, the gas companies reserve the right to obtain equipment for additions and replacements from competitive radio sources if the telephone company cannot meet the performance, price and time-schedule requirements of the gas companies.

Counsel asserted to the California commission that, "We have confidence in the contract obligation and representations of the Pacific Telephone Co., plus our own ability to protect the gas companies' rights to private radio frequencies before the FCC; and that commission has long recognized the public interest and importance of private radio frequencies allocated to aid safe and dependable gas utility service."

technical trends



• By GUY CORFIELD

Explosion and detonation

It has been established that under certain conditions a natural gas-air explosion, traveling on a combustion flame front through a pipe, will be converted into detonation with great increase in velocity, pressure and destructive force. Normally the combustion wave will travel at a velocity of 100 ft per second or less, and develop pressures less than 100 psi, which a pipe can withstand without damage; but if detonation develops the wave velocity will increase to several thousand feet per second with "impact" pressures of several hundred psi, which may cause severe rupture.

One practical aspect of this phenomenon is the possibility of significant damage to piping that may contain a combustible gas-air mixture, either accidentally or during placement in or out of service, and may accidentally become ignited. Field studies were made of this and reported by Elting Henderson in GAS, Sept. 1951, p. 23, under the title of "Combustible Gas Mixtures in Pipelines."

It was shown by these experiments that, in 337 ft of 4-in. pipe, with approximately "ideal" mixture of natural gas and air, at initial pressure approximately atmospheric, ignition would in some instances result in pressure build-up that would rupture the pipe. These results, and some other data available in general technical literature, have pointed to the overall desirability of avoiding combustible gas-air mixtures in piping and closed vessels. However, information is rather meager as to the conditions under which detonation can be expected in regard to composition of gas mixtures, initial pressures and temperatures, size and shape of piping or vessels, location of ignition point with respect to closures or openings in the system, etc.; and the thought has been expressed that detonation will only occur under unusual circumstances, and that therefore expensive precautions to avoid formation of combustible mixtures during short intervals are of questionable necessity.

An article in this connection has appeared on page 2558 of the December 1954 issue of *Industrial and Engineering Chemistry,* entitled "Natural Gas-Air Explosions at Reduced Pressure—Detonation Velocities and Pressures," by Gerstein, Carlson and Hill of the National Advisory Committee for Aeronautics, Lewis Flight Propulsion Laboratory, Cleveland, Ohio. These investigators were interested in systems that might contain unburned combustible mixtures, at pressures below atmospheric, and which were strong enough to withstand a combustion wave but not a detonation wave. They therefore conducted some experiments with stoichiometric natural gas-air mixtures at pressures from 0.4 to 0.2 atmosphere, to see if the characteristics of detonation could be developed. Natural gas was used with the reasoning that its principal constituent, methane, has relatively low flame velocity and therefore if it produced detonation, similar results could be expected from other combustible hydrocarbons.

The test system consisted of some 350 ft of 2-ft diameter pipe, of which 305 ft was a straight run, with a tee and short run at the entrance end, and a tee, short run, and enlarged plenum at the exit end. Facilities were provided for measuring the velocities of the flame front or combustion wave, and pressures along the pipe as the wave progressed.

Detonation occurred "in all tests in which a successful ignition was made." Flame front velocities started at from 65 to 176 ft per second, ranged from 1000 to 2000 ft per second at about 100 ft from the ignition source, and reached from 5600 to 7200 ft per second about 300 ft from the ignition source. Pressures, initially below atmosphere, rose to about 200 psia at 130 ft, 270 psia at 230 ft and 280 psia at 305 ft from the ignition point; and at the tee at the end of the 305-ft section a disc, rated at 465 psia failure, ruptured from impact pressure. After entering the enlarged plenum, where water sprays were also installed, it appeared that the velocities and pressures subsided to normal combustion values.

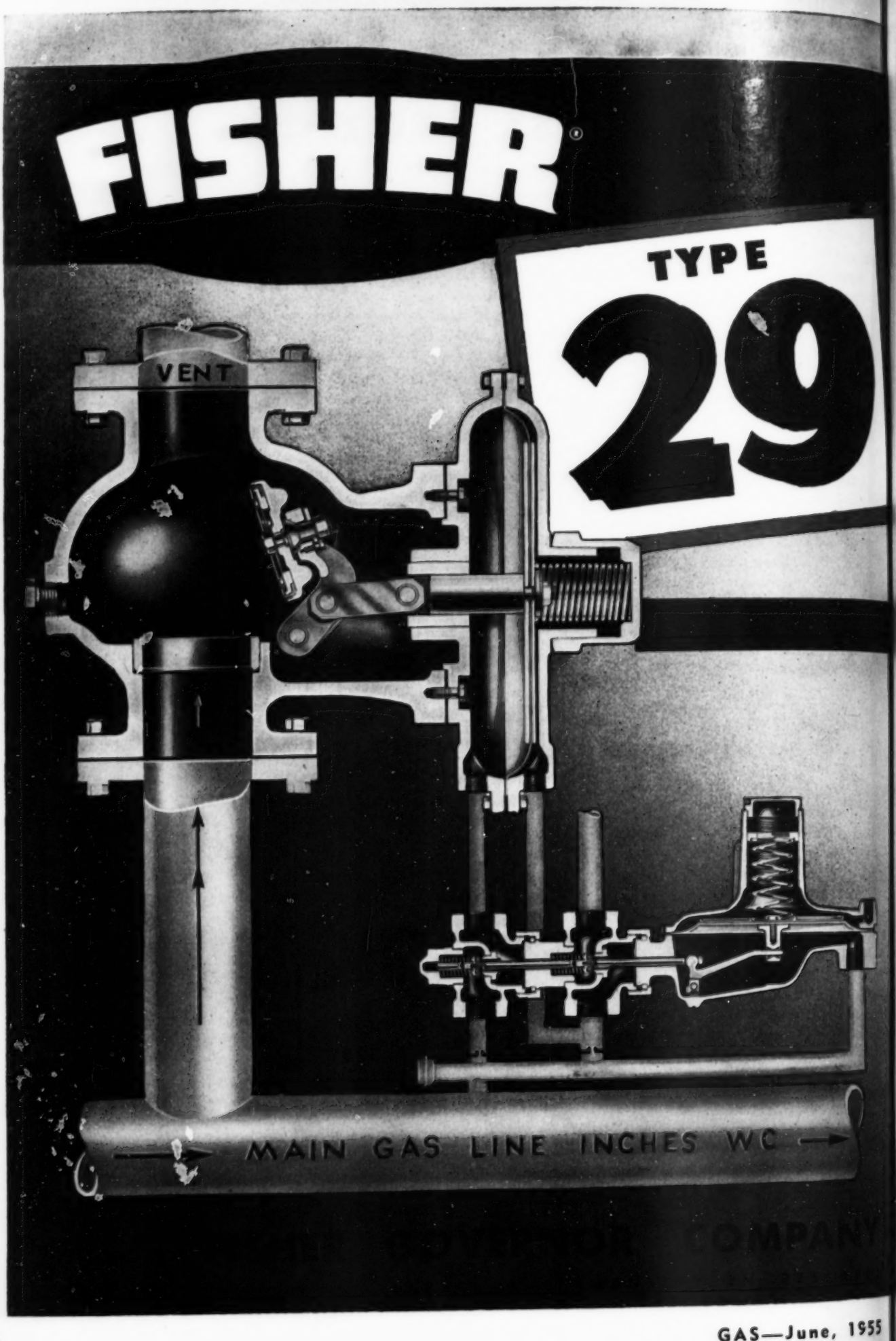
Paper thermometers

Many interesting devices have been developed for indicating or recording temperature, and several have been described in past issues of this page because they appear to have a particular usefulness in testing or control. One that has recently come on the market is the "paper thermometer."*

The type designated as "Thermopaper" is a graded series of heat-sensitive coated papers calibrated to determine temperatures from 115° to 490° F. They change appearance sharply from white to black at predetermined temperatures, the change occurring within a fraction of a second with an accuracy of plus or minus 1% of the stated temperature. This change from white to black is permanent, so the papers are ideally suited for determining maximum temperatures attained in ovens, rooms, locations not directly observable, etc., by installing several of different change-point at the location of measurement and later observing the one with the highest rating that has turned black. To a considerable degree they could therefore be substituted for recording equipment, and could be used by unskilled workers without possibility of error. They are available in 30 different temperatures with intervals of about 10° F, packaged in glass vials of 100 5/16-in. by 2-in strips.

For applications where the unprotected paper would not be suitable they are supplied as "Thermotubes," with the strip of paper sealed in a small glass tube. In this form they are available in 38 different temperatures from 100° to 470° F, packaged 25 in a box.

*Available upon request from Paper Thermometer Co., 10 Stagg Dr., Natic, Mass.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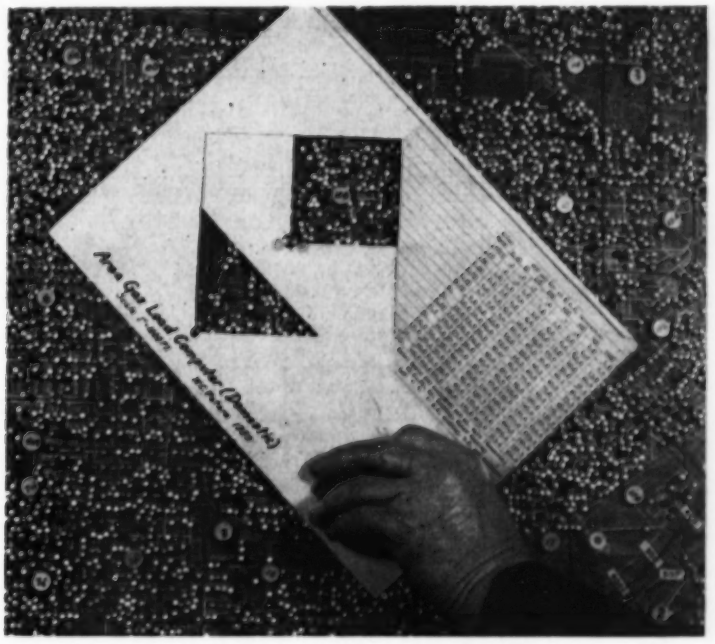
"Systematic and standardized types of system development become possible through the employment of accurate unit load data, coupled with a long range planning viewpoint approach. The 'get over the next hump' type of thinking can be avoided, and thereby each successive phase of system expansion becomes a permanent part of the expansion program according to plan.
"On the other hand, when any new construction is misplaced as to location, placed where not needed, or improperly sized, it can result in an unfortunate waste of materals and expenditures. In terms of dollars, the saving of one mile of 12-in. gas main that is wasted is approximately equal to an engineer's salary for life on the basis of current carrying charges."

GAS
JUNE 1955

LOAD DATA MECHANICS

... An answer to efficient main extensions

By WALTER C. PETERS
Northern States Power Co., Minneapolis



Total low pressure instantaneous demand can be determined with an area gas load computer. By adjusting the computer to any area, gas load for any gas space heating saturation can be added directly. Adding provisions for spot loads gives the total capacity of district regulator needed. (This photo is referred to as Fig. 7 in the text.)

THE factors involved in designing a new gas distribution system or providing for rapid expansion of an existing system present a real challenge to the distribution engineer. A pratical approach to this problem is presented, which attempts to utilize appropriate load data in the basic design. These data are incorporated in the formula for immediate and long range planning in a manner that tends to keep the system geared to the yearly growth in gas demands.

General considerations

No pretense is made that this method is "the" solution to distribution system design. It is rather "a" solution that has proved out and is given for the consideration of those companies facing the tremendous expansion made possible with natural gas. It may also provide a means of comparison for companies using other methods, or be of some general interest to those engaged in various phases of the gas business.

Since the usual case of system expansion involves existing gas facilities to some degree, application of the methods in system design will be concentrated on that type of system. Expansion for new districts beyond the mains, or completely new systems for cities, towns, or suburban areas are usually a more simple design problem. The application of load design methods will also be included for these.

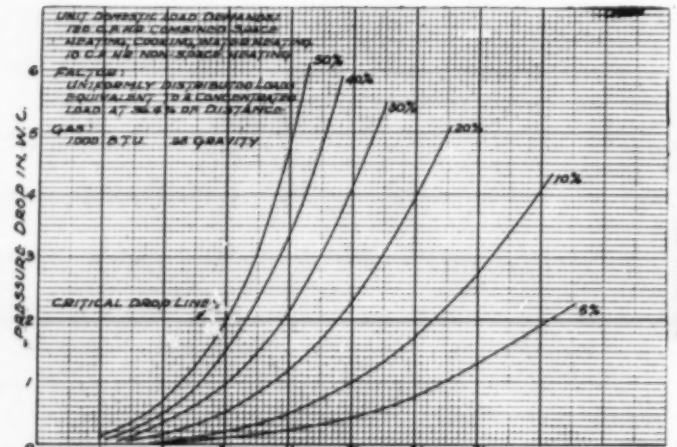
Abnormal expansion

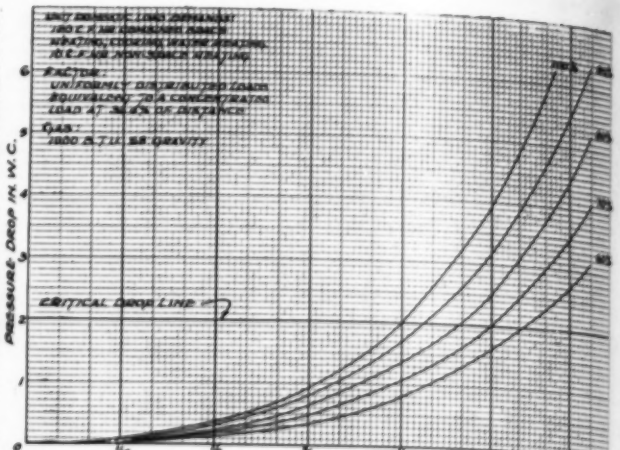
When a distribution engineer is confronted with abnormal expansion of gas systems for which he is responsible, unless he already has a sound long range plan up his sleeve, he has, as many of you have experienced, quite a job on his hands. Obviously I cannot digress into the studies and decisions on whether the system is adaptable to pressure elevation, what rehabilitation is required, whether the existing system should be retired in part or whole, what safety control equipment should be selected, what pressure ranges should be employed, and the many other items clamoring for attention. It is hoped, however, that the data given may be helpful in making some of the decisions.

The subject of present and future expansion possibilities of the present system in relation to successive increments in expected gas loads and ultimate instantaneous demands is one of the $64 questions.

This article is adapted from a talk presented at the AGA distribution conference, April 12-15, in Cincinnati.

Curves for determining critical drop according to size and househeating saturation





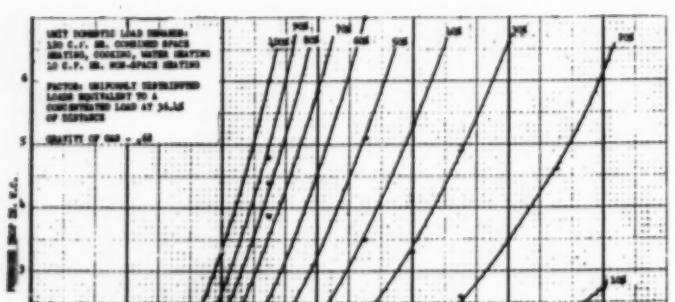


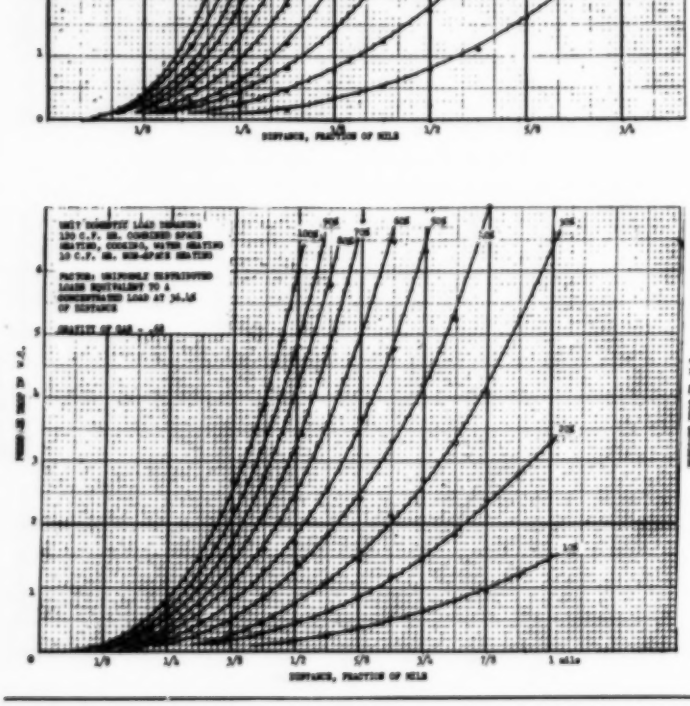
Fig. 1 (upper left). Four-inch gas main capacity curves (5% to 50% space heating).

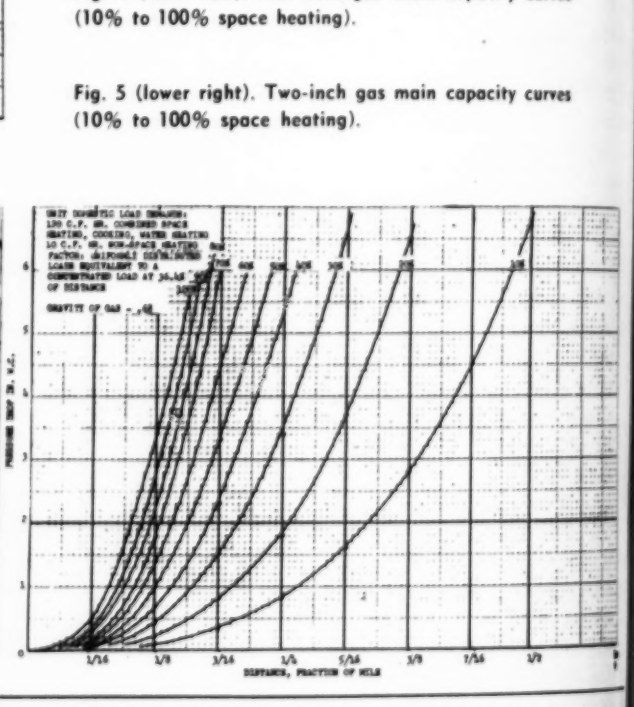
Fig. 2 (upper right). Four-inch gas main capacity curves (60% to 100% space heating).

Fig. 3 (left). Three-inch gas main capacity curves (10% to 100% space heating).

Fig. 4 (lower left). Four-inch gas main capacity curves (10% to 100% space heating).

Fig. 5 (lower right). Two-inch gas main capacity curves (10% to 100% space heating).





The distribution engineer should project his thinking into *what loads the system must be prepared for—not how much will the system take.* Never should the admission have to be made "We have run out of system capacity." On the contrary, the reinforcement of a system should be on a tailor-made step-by-step basis, each step justified on a feasibility and cost basis. Perhaps the most appropriate comparison of this is a jigsaw puzzle where we can see the ultimate completed picture in advance, but place the individual pre-cut pieces according to a progressive development plan to build that complete picture. Pieces to be taken out, reshaped or replaced should be kept to an absolute minimum.

So far, we have dealt with generalities that might be applicable to any method

of expansion design. Practical and specific information is what is needed to start the detailed system design operations.

Load data . . . Three types of data are required to make provisions for system capacity

Data requirements

When considering customer loads and system requirements, it is usually found that the domestic gas customers form the bulk of all customers, and, as such, require the major part of the system network to serve them. Three classifications of data are required to make the necessary provisions for system capacity. We must have some unit load data. We should know present and expected ultimate customer density, usually figured in customers per mile of main. Lastly, we need a figure on expected ultimate space heating saturation.

It should be explained that in this method of system design, the term "space heating saturation" is employed in a slightly different manner from the normally accepted practice. Instead of considering space heating as a percentage of total customers, it is applied as a percentage of the *predetermined ultimate customer density* in terms of customers per mile of main.

That is necessary to establish a uniform unit of measures in gas flow determinations as incorporated in the gas main capacity curves. Any needed flexibility can be provided by varying the density to meet the expected requirements for any particular area.

From the three classes of data, we can compute (except for spot loads) the maximum hour instantaneous demand in cfh for any area considered. Study of these results will determine how present facilities can best be utilized in meeting the final objective—the loads the system must be prepared for.

Naturally, there are many combinations of loads, sizes of lines and pressure drops for which no single solution can be given. For our example we will take a far north location, which presents perhaps a somewhat tougher problem in system expansion design. Before getting into the detailed calculations, we must make a number of assumptions. The gas will be presumed to be 1000 Btu natural gas, .68 specific gravity, as delivered into the system. The location is assumed to experience 95 degree days, which, interpreted into combined space heating and other domestic gas loads, calls for a 120-cfh unit customer demand. The non-space heating domestic demand will average 10 cfh.

Data from the sales department will be assumed to specify an ultimate customer density of 200 customers per mile and space heating from 80% to 100% saturation for various areas in the city. Some suburban areas may have ultimate customer densities of 125 customers per mile.

It will be further assumed that the present system is generally on a low pressure basis and made up of 4-in. gas main laterals supplied by larger diameter feeders. Preliminary studies of the system have indicated the advisability of keeping the system on low pressure within its present limits. Final decisions on this are to rest on long range planning calculations.

Pressure control standards have been established. Pressure drop calculations are to limit maximum pressure variations within approximately 33⅓%, up or down, of base pressures, normally maintained at 6-in. wc.

Successive pressure drops in the regulator districts are to be held within the following limits. Maximum drops shall not exceed 1.5 wc in feeder mains, 2-in. wc in laterals, .3 wc in services and .5 wc through the meter. Specific locations may vary from the above, but accumulative drops shall not exceed 4.3 wc.

In order to conform with the 33⅓% pressure variation limit, the district

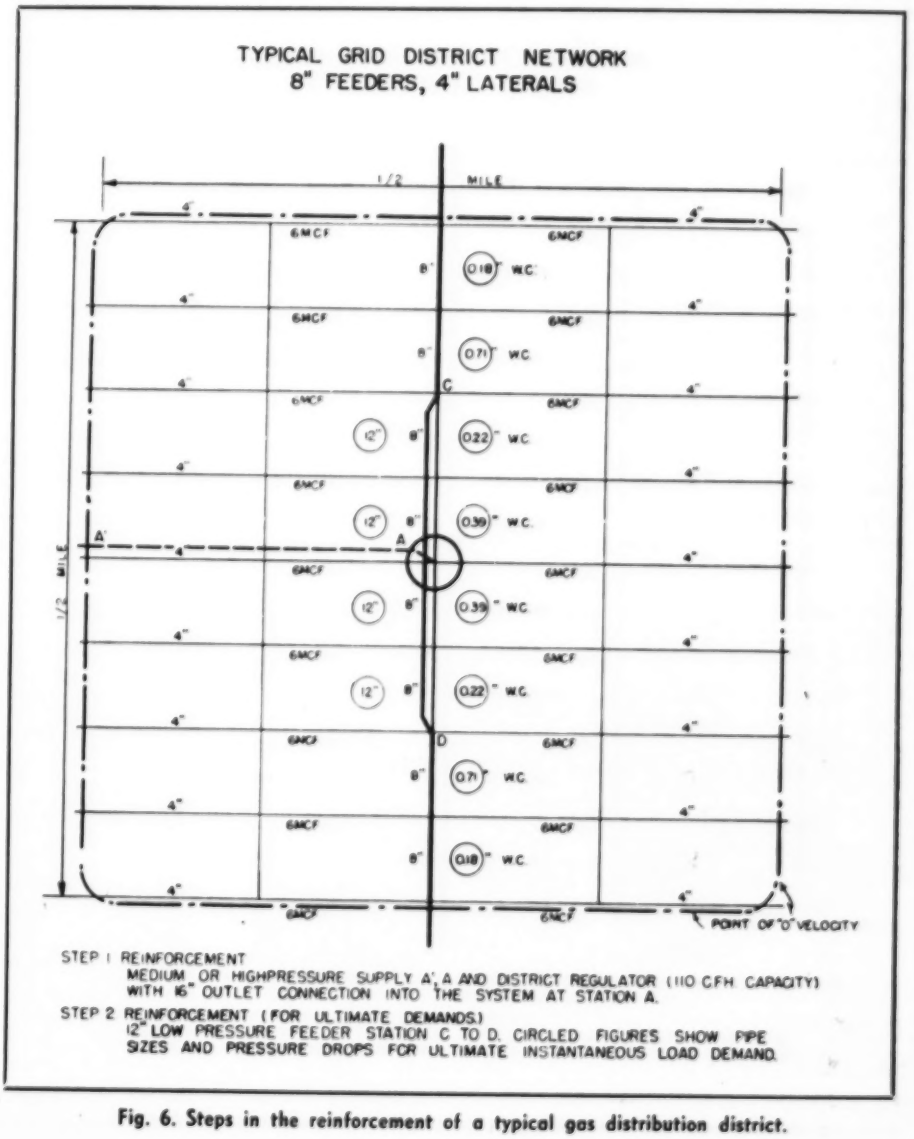

TYPICAL GRID DISTRICT NETWORK
8" FEEDERS, 4" LATERALS
1/2 MILE
6MCF
0.18" W.C.
0.71" W.C.
0.22" W.C.
0.39" W.C.
12"
8"
4"
A
C
D
POINT OF "0" VELOCITY
STEP 1 REINFORCEMENT
MEDIUM OR HIGHPRESSURE SUPPLY A', A AND DISTRICT REGULATOR (110 CFH CAPACITY) WITH 16" OUTLET CONNECTION INTO THE SYSTEM AT STATION A.
STEP 2 REINFORCEMENT (FOR ULTIMATE DEMANDS)
12" LOW PRESSURE FEEDER STATION C TO D. CIRCLED FIGURES SHOW PIPE SIZES AND PRESSURE DROPS FOR ULTIMATE INSTANTANEOUS LOAD DEMAND.

Fig. 6. Steps in the reinforcement of a typical gas distribution district.

Load data . . . Individual loads are considered uniformly distributed

regulators must provide for a 2-in. wc boost to 8 in. on peak instantaneous demands. That amount of loading should then provide 6-in. wc at the midpoint and 3.7-in. wc at tail ends to the customer's house lines at peak periods.

Whether the method of boosting pressures is by typical area, velocity or temperature loading, is beyond the scope of this article. It is imperative however, that the method selected be dependable in order to avoid unsatisfactory pressure conditions. The value of the 2-in. wc loading is obvious when it is considered that system capacity is increased about 37% by permitting a 4.3-in. wc drop against 2.3-in. wc, and yet maintaining more constant pressure throughout the major part of the regulator district.

The need for utilizing the maximum capacity of every gas line may be emphasized by examination of load increase factors associated with space heating.

In our typical case, the percentage increase in instantaneous demand resulting from space heating may appear somewhat astronomical. A non-space heating demand of 10 cfh raised to 120 cfh is an 1100% boost. One space heating customer's demand becomes equal to 12 customers' 10-cfh demand, or equal to the previous load for one side of a 660-ft block. Each successive gas heating customer adds over 1000% to his previous demand.

We will throw all the foregoing data into the hopper and see what comes out. One of the most valuable means for determining whether a workable combination is possible is to construct gas main capacity curves, based on data appropriate to the case. Where space heating is the item that causes the big load increase, curves should be prepared which show how far our 4-in. main laterals can carry various saturations of space heating within the limits of the critical 2-in. wc drop line. Such curves for space heating saturation from 5% to 50% are shown in *Fig. 1*, and saturations from 60% to 100% in *Fig. 2*. These capacity curves were computed with the general low pressure flow formula, as shown on the *American Gas Journal* Low Pressure Gas Flow Computer.

Individual loads are considered uniformly distributed and, as such, are equivalent to carrying the total as a concentrated load 36.4% of the distance.

These curves make no provisions for spot industrial and commercial loads, which must be considered as a separate class. They also make no allowance for possible main deposits.

Exhausting system capacity needed for domestic loads can be minimized by prudent placement of feeders in the various pressure classes. If feeders can be placed at the desirable intervals and also be in close proximity to the bigger loads, so much the better. Accessibility to rail or water shipping facilities, city zoning, topography of the ground, etc., are

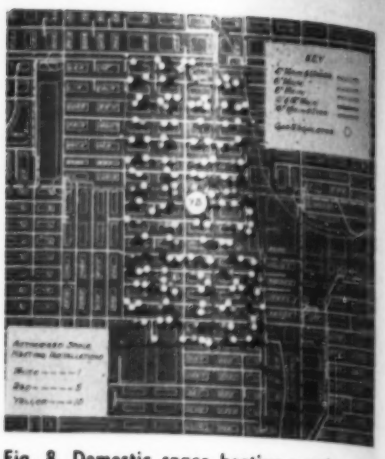


Fig. 8. Domestic space heating pegging map used in the initial preparation of area gas load data.

factors that indicate where to expect the larger loads, and thereby serve as a guide in network planning.

It is fortunate that large domestic loads due to space heating often take up greater street frontage and thereby conform to the gas main capacity curves.

Let us examine the assumed situation in respect to the critical drop line. *Fig. 1* shows that in the early phases of load growth, 10% space heating can be carried on the laterals slightly over ¾ of a mile single feed, or 1½ miles between feeders, double feed. At 30%, the distance is cut to ½ mile single feed, 1 mile double feed.

Fig. 2 projects our picture to ultimate requirements. One hundred percent space heating hits the 2-in. critical drop line right on the nose at ¼ mile, a situation that will permit using existing laterals with feeders at ½-mile intervals. *This will, therefore, be the basis of system expansion for the assumed case.*

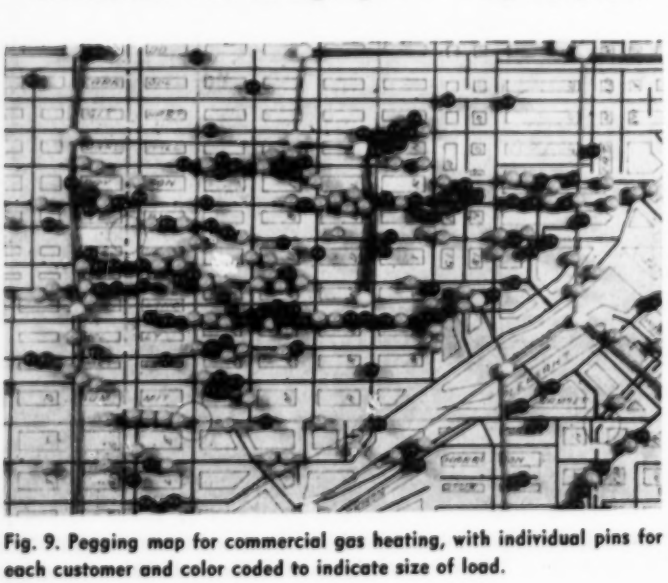


Fig. 9. Pegging map for commercial gas heating, with individual pins for each customer and color coded to indicate size of load.

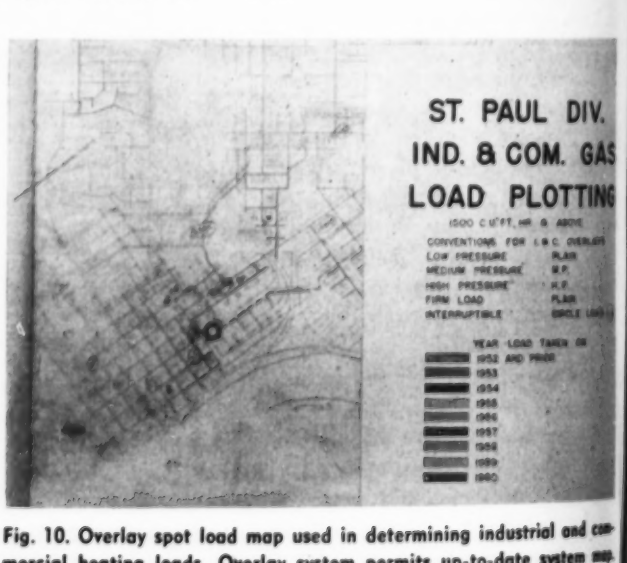


Fig. 10. Overlay spot load map used in determining industrial and commercial heating loads. Overlay system permits up-to-date system map.

The position and spacing of feeders becomes increasingly important as the long range pattern is developed. This phase of planning is a measure of design efficiency that can have a considerable effect on budget requirements.

Curves for lower customer densities in outlying areas with ranch type construction are shown in *Figs. 3* and *4*. They are figured for 125 customers per mile of main, but at the same unit loads stipulated for our example. Curves in *Fig. 5* are shown only for the purpose of proving the inadequacy in attempting to use small diameter main in a low pressure system expansion program.

Feeder requirements

It was specified that the feeders or gathering lines carry their loads with a maximum 1½-in. wc drop.

It already has been established what ultimate spacing of feeders may be required. The size depends on their length and on the number of laterals to be carried between successive gas supply points in the systems. Allowing some cushion and using the 100% saturation figures, we arrive at 50 customers for ¼ mile at 120 cfh each, or 6 Mcfh demand. Feeding both directions amounts to 12 Mcfh demand per block of feeder main. Study and calculations of the present feeder system and its potential capacity through the addition of regulator stations and feeder reinforcements provides the final plan. The choice between more regulators or more or larger feeders depends on the individual situation, and varies usually in different parts of the system.

As an example of a normal domestic area in the grid network system, let us take a district where an existing 8-in. feeder supplies 4-in. laterals at 330-ft block intervals. It is expected that ultimate loads will reach the 6-Mcfh demand level per quarter mile, or a 12-Mcfh total two-way feed from each supply point on the feeder.

The reinforcement of the district can be in two steps, as shown on *Fig. 6*. The first step would call for a new gas supply line A′-A, and a district regulator as shown.

Step 2 would consist of a 12-in. feeder out from the regulator between Stations C and D. This would be scheduled at the time the accumulative pressure drops in the feeder, laterals, service, and meter exceed 4.3-in. wc in the yearly system expansion calculations.

It is presumed that the 8-in. section of paralleled feeder main is to be retired because of obsolescence.

When final density in customers has been reached with maximum saturation of space heating, pressure drops should again conform to the stipulated pressure control standards. Total feeder drop should be 1.5-in. wc, lateral drop 2.0-in. wc, and combined service and meter drop .8-in. wc.

Where spot loads are scattered throughout domestic areas, additional consideration must be given to regulator capacity and supply lines as outlined.

When the best combination of district regulators and mains has been determined for all areas, that data can be placed on a long range planning map. The sizes and locations of mains calculated then control the year-to-year expansion in a manner that the work completed becomes finished business. *System rehabilitation can secure maximum benefits when tied in with the long range plan.*

Where expansion may be slow, particular attention must be given to the cost of over building and resulting high fixed charges. The progressive development plan described appears to have definite advantages in that each step can usually be justified, as needed.

District load determinations

When we have progressed to this point in system expansion design, our sights should have been raised to the ultimate target. Natural barriers, the grid network pattern, and other considerations should make the regulator districts rather clearly defined. We are here chiefly concerned with maximum firm domestic loads, and the industrial and commercial spot loads as were predicted by the sales department. Large interruptible, as well as abnormal firm spot loads, we should attempt to serve directly from the higher pressure classes of feeder main.

Total low pressure instantaneous demand can be determined by adding ultimate predicted gas main loads, or by an area gas load computer, as shown in *Fig. 7*. This computer, designed in 1950, is nothing more than an adjustable shutter built to a 1000-ft-to-the-inch scale with a table of computed gas loads for various sized areas up to 1 mile square. Data shown are based on unit load and customer density values as presumed for our example, and shown for space heating saturations from 2.5% to 100%. Tables with other values can readily be applied to the computer.

By adjusting the computer to any area, gas load for any space heating saturation can be read directly. Adding provisions for spot loads gives the total capacity of district regulator needed. This figure then becomes the basis for design of higher pressure class supply lines to regulators, as well as a means for sizing the regulator.

Distribution network supply lines

The total of all district regulator demands, in low or higher pressure service, plus the demands for individual large volume customers supplied directly from feeders, constitute the maximum instantaneous demands expected on the system. Considering the ultimate loads to which network supply lines may be subjected may help in determining initial sizes and pressures for lines, planning backfeed reinforcement, or laying out additional loops.

It already has been explained what is considered important in the pattern and location of feeders in the various pressure classes as they affect the individual regulator district.

The greatest over-all value to system capacity is that of backfeed. Backfeeding a system network can, as you know, quadruple the gas supply in the feeder systems. The same expansion factor is also secured in any part of the system where backfeed can be provided.

Application of this principle to a number of gas properties has disclosed that the most efficient use of the network supply feeders was obtained by lines in the shape of a cross covering the central heavily loaded part of the system, circled by successive loops of pressured lines. The cross can supply district regulators in the central business district, as well as spot loads in any of four directions.

The network loop feeder that circles the existing low pressure system can be utilized to backfeed into the outer ring of low pressure district regulators and to serve as a supply source for new area expansion usually carried on medium or higher pressure.

Attention to the selection of routes for these lines cannot be overemphasized. To what extent interruptible loads should be figured as carried concurrently with firm gas loads must be considered according to specific conditions and policies existing in the particular locality. The biggest factor in

Load data . . . Worksheets may also show excess capacity for space heating or other load

arriving at a design policy on this is the ratio of interruptible loads to firm gas peak demands. A typical formula that has been used is to use the higher of the following values: 75% of maximum firm plus 100% of interruptible, or 100% of maximum firm demands with no interruptible.

Yearly system expansion calculations

The most accurate advance load calculations can be made when it is known where existing loads are and where and how much new load is expected.

The first part, the present load, can be determined quite easily if three types of visual aids are used. A system scale map, preferably to the same 1000-ft-to-the-inch scale as the gas load computer should have all domestic space heating pegged on it at the time units are authorized. Color coding the pins, such as white for one unit, red for five and yellow for 10, keeps the map from getting jammed with pins. A section of a domestic space heating pegging map is shown in *Fig. 8.* A second pegging map can be used for the commercial heating loads with individual pins for each customer, and color coded to indicate size of load. A section of such a map is shown in *Fig. 9.* A third visual aid, where needed, can be used for showing large spot loads of firm or interruptible types. An overlay with color conventions can indicate the size load, whether firm or interruptible, and from what pressure class supplied. The overlay system permits keeping an up-to-date system map under the overlay. Such a spot load map is shown in *Fig. 10.*

Here is how the combination can be used The domestic space heating map can show a perpetual total of all space heating. It also can have the regulator districts "fenced in" to show approximate borders of each district. We will assume that 1956-57 heating season system expansion estimates are to be made. All pegging on all maps is discontinued long enough to make a space heating count of installations in all districts. The total is listed for each regulator district on a master load sheet. Predicted house heating additions are applied by means of a percentage increase factor for the coming year. Some deviation from a straight line prediction may be necessary since new districts, already solid space heating, will not be double decked with another set of dwellings. Correction for error in any district that did not follow the prediction factor from the previous year is automatically accomplished by the new count. Demand, in our example, was given at 120 cfh for combined unit load.

Non-space heating customers are taken as the difference between total customers in the district and the predicted space heating total. Unit demand was specified at 10 cfh.

Commercial heating calculations vary from the domestic class in that the load per customer is taken from the map. To these are added the sales department predicted new loads for the particular district. The total of the foregoing is the predicted commercial heating demand listed for each district.

Other industrial and commercial connected loads are taken from the current sales file and have added to them new load predictions. For design purposes, these loads are figured with a demand of 60% of connected load values. It is admitted that there is some error in this for any individual customer, but on a system basis, it has worked out satisfactorily.

Large spot loads, if any, are treated according to a source of gas supply and as to firm or interruptible.

The projected totals of the groups of predicted loads for each district are totaled for all districts. This grand total gives the expected instantaneous demand for the maximum hour of the heating season computed.

In the early years of gas expansion with space heating, it is advisable to allow some additional space heating capacity as a diversity factor. To start with, this might be as much as 10% of total predicted space heating customers, since it is not possible to predict the exact location of these loads.

Regulator district reinforcement (low pressure)

An overlay or black and white map section of each district, a work sheet, a set of gas main capacity curves, an area gas load computer and a gas flow computer are needed for making district reinforcement computations.

The totals of each group of predicted gas loads are placed on the work sheet. Visual examination of the pegging maps is usually sufficient to split up the predicted loads to the various mains in the district. Making pressure drop calculations is relatively simple. Where ultimate density of 200 customers per mile of main is the design basis, a count of present space heating on one of the outlying streets in the district for a ½-mile distance gives the direct percentage of existing space heating saturation. Multiplying this by the appropriate prediction factor gives the anticipated saturation. Checking this with the comparable saturation curve for the length of main, as taken from the pegging map, gives the pressure drop. This can be done as fast as it takes to tell about it. It may be advisable to make the same check on a lateral main at the opposite extreme end of the district.

The pressure drops in the feeder or feeders from the regulator are calculated in the normal manner. If total drops for feeder, lateral, service and meter are not in excess of 4.3-in. wc, no reinforcement is needed. Where existing feeder capacity is exhausted and pressure drop limits are exceeded, the gas load computer can be applied to the area for computing the ultimate requirements. The yearly reinforcement of the district can then be on a step-by-step basis, as required, to conform to the ultimate long range plan set up for the particular district.

Any reinforcing materials are listed on the work sheet. Material totals for district reinforcement plus the feeder network requirements go into budget and material procurement considerations.

Regulator district work sheets may also show any excess capacity for space heating or other loads. An approximate calculation can easily be made on the basis of pressure drops. Where the accumulated pressure drop comes to less than 4.3-in. wc under the conditions stated, the square root of the drop compared to the square root of 4.3-in. wc is the ratio of total predicted load to the maximum allowable load for this regulator district.

Should gas loads develop in excess of all the provisions made, as have been previously outlined, a simple and prac-

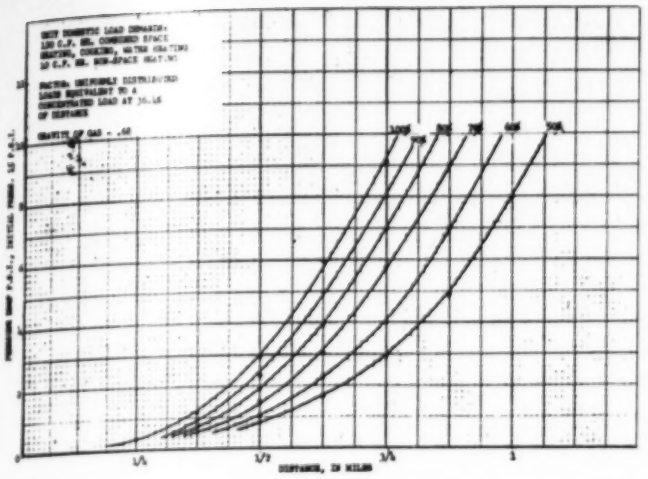


Fig. 11. Two-inch gas main capacity curves, Class II, medium pressure (50 to 100% space heating).

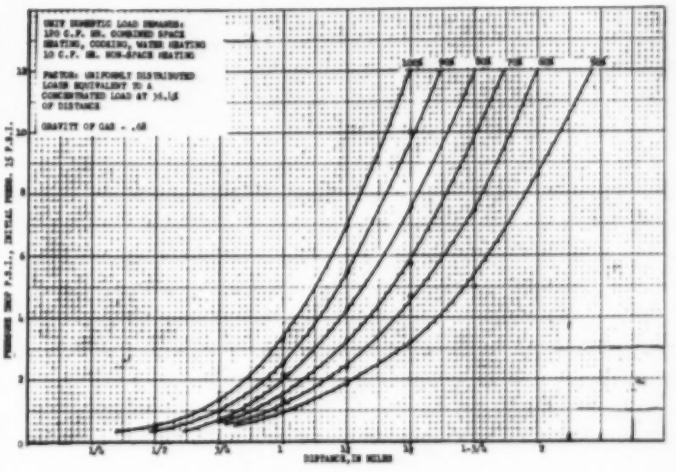


Fig. 12. Three-inch gas main capacity curves, Class II, medium pressure (50 to 100% space heating).

tical method of handling them has been included in the described method.

It is obvious that prudent design does not warrant "over building" regulator districts beyond normal expected loads. However, unusual load situations may develop in any one area that can be taken care of as follows: By installing an appliance regulator on the house lines of all customers in the immediate proximity of the district regulator, peak hour pressure boosting can be increased. The appliance regulator should be on a house line supplying all gas appliances not already so equipped.

Increasing the 2-in. wc boost already described to 4-in. wc will increase the capacity in the district to about 65% above that at a 6-in. wc base pressure.

Should this require a total of 100 regulators for the four directions out from the district regulator, the cost of this added volume, if and when needed, would be about $700. This is considered to be a modest expenditure for correcting an extraordinary situation.

It should be mentioned that automatic boosting of base pressures, both to achieve the 2-in. boost for 37% increase in capacity, or a 4-in. or higher boost should be by a method that will be positive and not interfere with the pressure control of adjacent district regulators.

Regulator district reinforcement (medium pressure)

Descriptive material given on a load basis method of design for low pressure distribution with the regulator districts is considered sufficient to show a similar application to medium pressure systems. In this case, medium pressure main capacity curves are required. Capacity curves for suburban areas with ultimate densities of 125 customers per mile of main will be assumed appropriate for our example. Space heating saturations from 50% to 100% for 2-in. main are shown in *Fig. 11* and for 3-in. main in *Fig. 12*. If we examine these curves, we will see that both the initial and yearly reinforcement design can be relatively simple. If 2-in. laterals are selected for areas where expansion is limited to a distance of ½ to 1 mile from the supply header and 3-in. or larger laterals are selected where expansion is apt to be more or less unlimited, very little attention is necessary in the yearly calculations. When saturation reaches 50%, in the case of the 2-in. laterals, a header is required at one mile from the original header. For 3-in. or larger laterals, headers at two-mile intervals do the trick.

A precaution to be observed is that the headers should be on, or near, the main streets or highways. These are usually the locations where larger loads or mushrooming housing developments may be expected.

Szie and length of headers between successive supply points depends on the dictates of the particular situation.

Summary

I have attempted to illustrate the mechanics of applying gas load data to system design. The greatest possible use of visual aids has been shown both for maintaining a perpetual record of loads, as well as the mathematical procedures of interpreting and applying proper load values to progressive design.

Particular attention was directed at long range planning and ultimate loads. The distribution engineer was cautioned to heed *"what loads the system must be prepared for"—not "how much will the system take."*

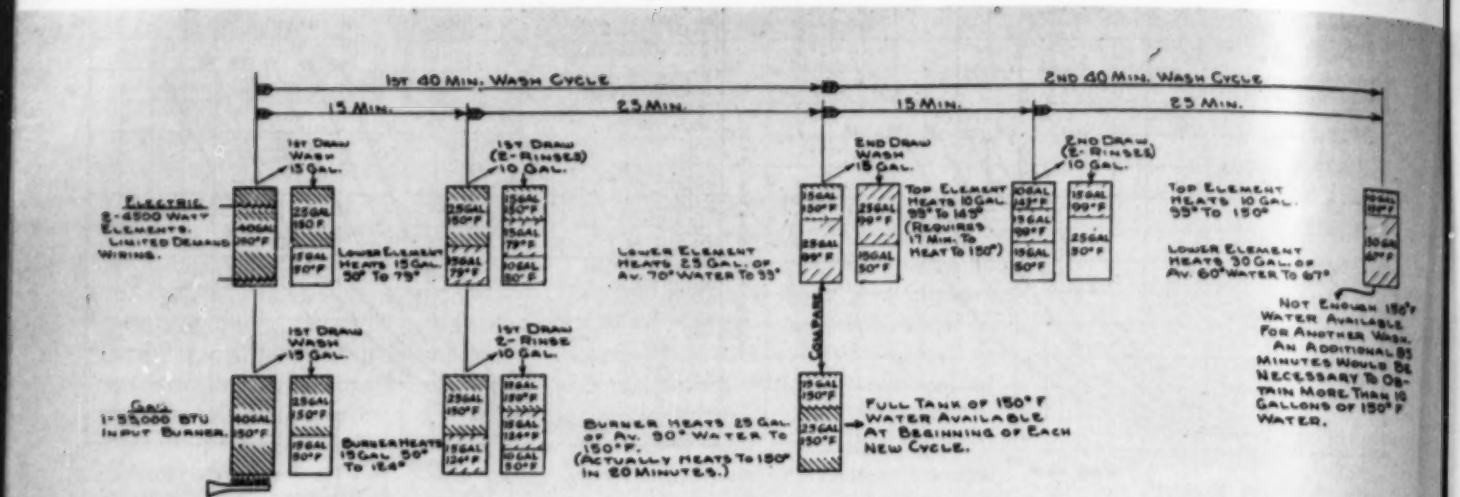
A hypothetical case to which specific values were assigned was used to show the details involved in the application of the load data method of distribution system design. In this method, any appropriate load values can be substituted to meet any local needs. The flexibility provided permits any time to time adjustments needed as they can be ascertained from the actual experience table.

It is usually agreed that the proof of the pudding is in the eating. A utility with 94,000 meters that had its expansion design based on the load data method came through its peak demand in the 1953-54 season with only 68 customer calls for all reasons, for the peak day. Saturation of space heating was 37% and customer calls averaged 1.4 call per 1000 meters.

These results, added to a total record of four years of quite satisfactory pressure conditions with this system, indicate the results possible with load data design.

Every gas utility attempts to maintain ideal operating conditions for the utilization of gas in the customer's gas appliances. The accomplishment of that objective calls for greater elimination of "hit and miss" design practices and avoidance of the blind spots in determining system load data.

Any method in design, or combination of methods, that can contribute toward greater perfection in the delivery of gas to the customer, under any and all conditions, puts added meaning into the gas business slogan, "If it is done with heat, it can be done better with gas." ■


1ST 40 MIN. WASH CYCLE
2ND 40 MIN. WASH CYCLE
15 MIN.
25 MIN.
15 MIN.
25 MIN.
ELECTRIC
2-4500 WATT ELEMENTS.
LIMITED DEMAND WIRING.
1ST DRAW WASH 15 GAL.
1ST DRAW (2-RINSES) 10 GAL.
LOWER ELEMENT HEATS 15 GAL. 50° TO 79°
LOWER ELEMENT HEATS 25 GAL. OF AV. 70° WATER TO 93°
END DRAW WASH 15 GAL.
TOP ELEMENT HEATS 10 GAL. 98° TO 149° (REQUIRES 19 MIN. TO HEAT TO 150°)
2ND DRAW (2-RINSES) 10 GAL.
TOP ELEMENT HEATS 10 GAL. 95° TO 150°
LOWER ELEMENT HEATS 30 GAL. OF AV. 60° WATER TO 67°
NOT ENOUGH 150° WATER AVAILABLE FOR ANOTHER WASH. AN ADDITIONAL 85 MINUTES WOULD BE NECESSARY TO OBTAIN MORE THAN 10 GALLONS OF 150° F WATER.
GAS 1-55,000 BTU INPUT BURNER.
1ST DRAW WASH 15 GAL.
1ST DRAW 2-RINSE 10 GAL.
BURNER HEATS 15 GAL. 50° TO 154°
BURNER HEATS 25 GAL. OF AV. 90° WATER TO 150° F. (ACTUALLY HEATS TO 150° IN 20 MINUTES.)
COMPARE
FULL TANK OF 150° F WATER AVAILABLE AT BEGINNING OF EACH NEW CYCLE.

Which heater provides the better hot water service? This comparison clearly shows the high-recovery gas water heater to be far superior with plenty of hot water available for consecutive automatic washer loads and for other household purposes at the same time.

How great is the threat of the new "high speed" electric water heater?

By KENNETH WOOD, Assistant Superintendent, Operating • East Ohio Gas Co., Cleveland

THE electric water heater industry is hoping to meet gas water heating competition with a smaller (40 gal.) size tank and higher wattage heating elements. Claims are being made that this new heater produces 50% more hot water in 24 hours than the current 82-gal. lower wattage units and the initial heater cost is half as much. Not much is being said about cost of operation as gas water heating continues to hold a tremendous advantage. This smaller size electric water heater must, of necessity, eliminate off-peak charging; this may even increase the electric rates and thus the operating cost of the heater. Experience also indicates that the user of an electric water heater is very conservative on the water usage. If the high speed electric water heater supplies more hot water, customers no doubt will be inclined to use larger quantities. This will also create higher cost of operation for the user.

General Electric Co. pioneered this higher speed heater in November 1954 and presently Westinghouse, Frigidaire, Hotpoint and many manufacturers who make both gas and electric water heaters are also either in production or developing higher wattage-small tank models.

The heater utilizes two 4500-watt heating elements. They are interlocked so when the upper 10 gal. is heated to 150° temperature, a double throw thermal switch cuts out the top unit and switches on the lower element to heat the lower 30 gal. of water. As water is used from the tank, the lower element cuts back in attempting to replace the used hot water. If a complete draw-off is made, the lower element cuts off and the upper unit is energized so that a small amount (10 gal.) can be heated faster.

Power companies are not permitting the high demand of two elements at the same time and many utilities are not yet willing to accept even a 4.5-kw demand. General Electric has been campaigning to convince electric utilities that wattage limitations should be removed and that a standard high wattage heater should be adopted. It is reported that at least 19 major utilities, representing about 25% of all electric meters in the country, have given approval to the 4500-watt maximum demand units. No doubt others will follow in the near future, but many of the bigger companies are still restricting the demand to 3000 watts. The gas industry is very fortunate in that no limits are established by utilities on the gas input to water heaters.

A very aggressive advertising program and an energetic promotion in the plumbing trade has been launched. The plumber is being wooed by various baits so that he will find it to his financial advantage to promote electric over gas water heaters. The smaller tank size has permitted lower initial cost and attractive offers are being made to builders.

General Electric in describing its "quick recovery features" states, "It's safe and clean and provides better hot water service than a flame heater." We

This article has been adapted from a talk presented at the AGA research and utilization conference held in Cleveland, April 27-28.

will go along with the statement it is safe and point out that gas-fired water heaters are equally safe. We will agree the electric heater is clean, but again the gas-fired heater is equally clean. "Better hot water service"! Many gas water heaters are capable of giving far superior performance over these new model electric heaters.

The new electric heater using two 4500-watt elements based on 95% efficiency and 100° F rise in temperature will recover from a cold start of 50° F water, 10 gal. through the upper element in 33 minutes and then 30 gal. in 100 minutes through the lower element. A total of 2 hours and 13 minutes is required to obtain 40 gal. of 150° F usable hot water, as only one element is permitted to be on at one time.

A current model 40-gal. gas water heater having an input of 53,000 Btu/hour and based on 70% efficiency and 100° F rise in temperature will recover 40 gal. in 54 minutes from a cold start. This is 2½ times faster than the so-called high speed electric heater. A lower input 40-gal. gas water heater having an input of 33,000 Btu/hour is 1.6 times faster than the electric.

The electric advertising, however, points out that after a complete draw-off the top 10 gal. will heat fast. This seems to be an admission that the high speed electric heater will run out and when it does, one will have to wait 33 minutes to obtain only a small amount of usable hot water. The high recovery gas water heater never faces this problem of run out because it keeps up with or ahead of the heaviest demands.

Complicated schedules

We need not get involved in complicated hot water draw schedules and debate how much water is required by various size families, various size houses, and various kinds of hot water-consuming appliances. Certainly a water heater should be able to easily supply enough hot 150° to 160° water in this modern age of living to wash clothes load after load in an automatic washer without waiting between loads. If the heater can do this, it will be able to handle all other household hot water requirements.

Let's look at a comparison diagram of the effects of a draw of 25 gal. of water as called for by an automatic washer during a 40-minute wash cycle. It is agreed that automatic washers vary considerably on hot water demands and, of course, some washers utilize the suds-saver where some of the warm water from the first wash is re-used. Many customers and many manufacturers however feel that fresh 150° or hotter water should be used for each wash cycle. Again the time of the wash cycle will vary, depending upon the clothes being washed and the preferences of the user. For this comparison you will note a 15-gal. draw and a 15-minute wash cycle is used. A shorter wash cycle would further aggravate the load on the water heater. At the end of 15 minutes it is assumed for this comparison that 10 gal. of hot water is drawn from the heater for two rinses. The rinse water temperature in many washers can be varied from lukewarm to hot and, therefore, it would seem that a 10-gal. draw would be a fair average. Many washers have a shorter overall wash cycle than 40 minutes, some going as low as 22 to 28 minutes. A 40-minute complete wash cycle would allow time in between washes for loading and unloading clothes. It could also be argued that people don't wash clothes load after load. Surveys however indicate that the majority of housewives do set aside a certain day for laundry and will wash upwards of five or six loads in consecutive order.

Which heater provides the better hot water service? The comparison (see drawing) clearly shows the high recovery gas water heater to be far superior with plenty of hot water available for consecutive automatic washer loads and for other household purposes at the same time. Will the customer see this picture before he makes the purchase?

Some might say here that the comparison would be greatly different if the electric utilities lifted wattage limitations and allowed the two 4500-watt elements to be used at the same time. It is agreed there would be some gain on recovery but if the electric water heater industry hopes to continue to capitalize on recovering a small amount of water fast the heating elements would of necessity have to be located and wired in the same manner as on the present heater. With such a wiring it would only mean that with both elements available at one time the lower 30 gal. of the water heater at the end of the second 40-minute wash cycle would be at an average temperature of around 90° rather than the 67° as shown on the sketch. Now if the power companies lifted all restrictions on wattage limitations and allowed the full demand of 9000 watts and if the present electric water heater manufacturers abandoned the sales story on recovering a small amount of hot water fast, the full input could be placed in the lower element, which would then make the water heater exactly the same as an under-fired gas water heater. It would have a recovery capacity of 36 gal. per hour. We would then be forced to admit that this electric water heater would give a performance comparable to our present 40-gal. gas water heater having a recovery capacity of 36 gal. per hour.

At this point it should be stressed that many 40-gal. gas water heaters today have inputs and recovery capacities that are far too low. In order to completely recover and have a full tank of 150° water available at the end to the first and each successive 40-minute wash cycle, be it gas or electric, an input will be required that will enable the heater to recover not less than 36 gal. per hour on 100° temperature rise.

Wide variation

Both gas and electric rates we know vary considerably throughout the country, and the amount of hot water used per month varies from family to family. However, let's compare the monthly cost of heating 3000 gal. of water from 50° to 150° F. The high-speed electric recovers 18 gal. per hour on each 4500-watt element if we assume 95% efficiency. Approximately 750 kwh would be used to heat 3000 gal. of water and, with a rather low rate of $.015 per kwh (off-peak charges will not be available or practical on this water heater), the cost will be $11.15. The high recovery 53,000-Btu-per-hour gas heater recovers 44.5 gal. per hour based on only 70% efficiency (the minimum AGA requirement). Approximately 3,454,000 Btu or 34.54 therms would be used to heat the same 3000 gal. of water. Using a rate of $.62 per thousand cubic feet of 1000 Btu natural gas, the cost will be $2.14. Yes, one-fifth the cost of using electricity. Even if a higher gas rate of $1.50 per thousand cubic feet of 1000 Btu gas were used, the cost would be $5.18, or one-half the cost of heating at the lower electric rate.

Is the customer willing to pay that much more for the privilege of using an electric water heater that has a lower standard of performance? The customer may not know about this high cost until after the heater is installed.

Water heaters of 40-gal. tank sizes, whether gas or electric, can be manufactured for comparable costs and per-

Electric vs. gas . . . Low cost electric heaters are the goal of electric manufacturers

haps the electric model can even be retailed at $20 to $40 lower than gas models. The present 40-gal. high speed electric heaters retail from $120 to $140, while gas heaters of similar construction sell for $130 to $160. Installation costs vary considerably for each individual situation, but under like conditions we will here assume they will be about the same on both models.

With a $20- to $40-differential in selling price, the plumber, the builder, and the customer might be attracted unless they know all the facts. Some plumbers and some builders might even know the facts, but feel they will not have to live with the heater day after day and will not have to pay the bill at the end of the month. Which heater will they install? Lower cost electric water heaters have been the goal of the electric manufacturers for some time. This lower initial cost with a story built around the quick recovery of 10 gal. of water in only 33 minutes is and will continue to be the basis for strong electric water heating competition.

Gas utilities should continue to maintain very aggressive advertising and selling programs directed to plumber, builder and user. Those who have not been active should become so, fast, and sell the advantages of AUI 40 (automatic, underfired and insulated minimum 40-gal. size) gas-fired water heaters. Forty-gallon tank size as a minimum, however, is not the complete answer in itself.

It would seem from our discussion up to this point that the hot water requirements of modern living can be satisfactorily met only with a water heater having a recovery capacity of approximately 36 gal. per hour or higher. While it is true that many gas water heaters of lower recovery capacity and even smaller tank sizes will do an acceptable job, and will outperform many electric models, now is the time to close the door to our competition by installing the best. AUI 40 has gone a long way in many areas toward establishing gas water heating as the best. Perhaps now is the time for the gas industry to consider adding another 40 to make our goal AUI 40/40. With a minimum of 40-gal. storage capacity and a minimum of 40-gal. recovery capacity, there would be no doubt about meeting the hot water requirements in our modern homes. It would seem that no matter how high the cost of gas in any given area there is no place in this increasingly competitive field for the low recovery gas water heater, especially when we are talking about a fuel that has no limits as to burner input. It is true that there are engineering problems to be overcome in design and construction but enough manufacturers have surmounted these problems to prove high recovery can be achieved. Why not make the water heater the standing servant of the customer at all times, and eliminate appliances that through "just acceptable" or "below standard" performance regulate the schedules and manner in which the family is to live.

High quality construction and long life should continue to be a consideration and initial cost should be kept as low as possible without sacrificing this quality. With the lower cost of operation offered by gas fuel it takes only a very few months to pay for normal differences in initial cost. It would be unwise to try under-selling at a sacrifice of either quality of construction or performance.

We should face the eventuality of electric utilities allowing a full 9-kw input on water heater installations and do all we can to sell the water heater that uses the fuel with unlimited input and which provides unlimited performance at lower cost. We must capitalize on these advantages now. ■

Ammunition for battle of the fuels

AMMUNITION for the gasman in "Battle of the Fuels" has been provided by the recent findings of the committee on comparison of competitive services of the AGA. Based on information volunteered by 92 gas utilities serving 61% of the total gas meters in the United States, the actual figures of the comparisons are published in a 26-page booklet available from the AGA.

To obtain comparisons between gas and electric cooking and water heating, the committee made studies in large groups of homes and had several agencies, working independently of each other, run tests to determine maintenance and operating costs.

Gas came out ahead on all counts. Cost of initial purchase of appliances, installation, operation, and maintenance were all items that were lower for gas than for electricity. The average purchase price of 30-gal. gas water heaters in operation was $109, whereas the average for the comparable 66-gal. electric heater was approximately $45 higher. The monthly operating cost of this gas water heater on the basis of 38-gal. per day usage was $2.69, whereas its electric counterpart consumed $5.15 worth of electricity during the same period. This 1.9 ratio climbed even further out of proportion as the amount of hot water per day went up. At the 100-gal.-per-day level, electric water heaters cost 2.3 times as much to operate as do gas units.

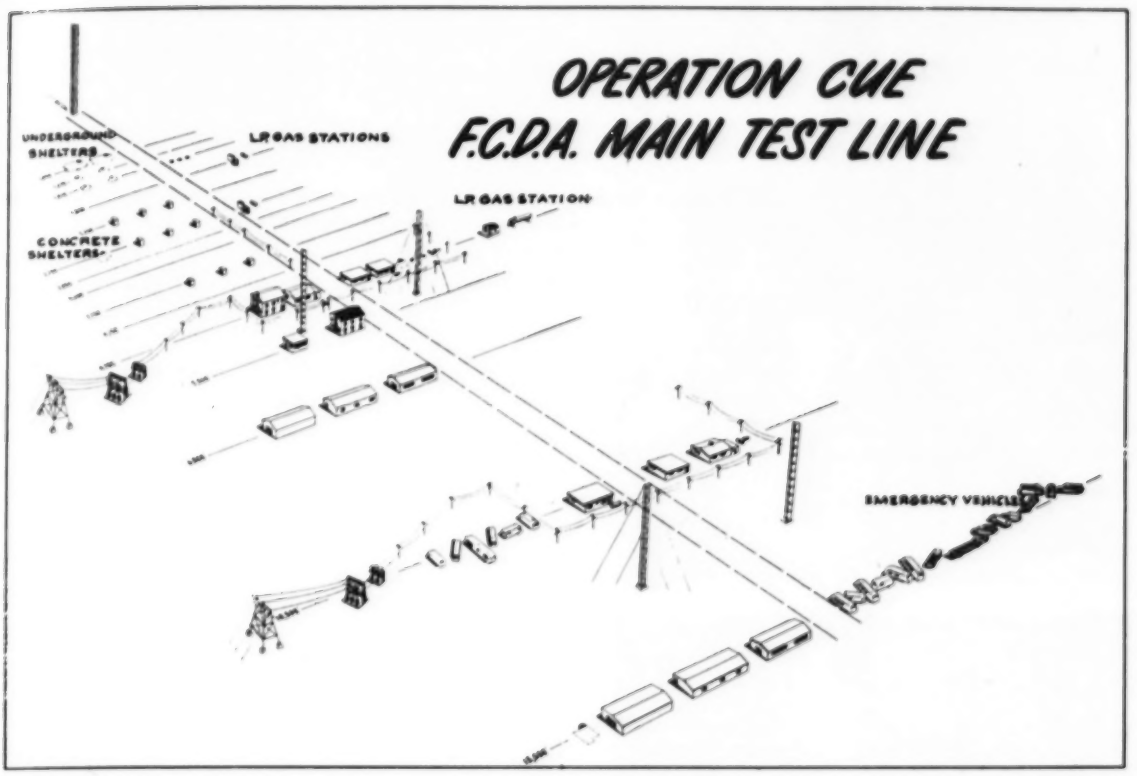
Cooking costs followed the same general pattern. The owner of the most popular gas range paid $218 initially, whereas his neighbor who favored electricity paid $270.41 for the most popular electric model. This represents $52 saved by the gas user at the very beginning. To have his gas range installed he paid approximately $6 less than his neighbor who already has three-wire service in his home, and he paid only 1/10 of the installation bill that his neighbor who switched from a gas range to electric cooking paid to have three-wire service run into his home and have his range connected.

The man with the gas range also saved on his cost of operation over the year. His bill over the 12-month period totalled $11.76 less than that of his neighbor using electricity for cooking. Also, his maintenance bills were less than his neighbors by $4.34.

The pamphlet includes a list of 73 towns and cities across the nation and shows how much more it costs to cook and heat water by electricity in those localities. These amounts run anywhere from $16.32 per year more, as is the case in Nashville, to $150.24, which is the additional amount paid by the average electrical user in Lawrence, Kan.

These figures are based on a hot water usage of 50 gal. per day and the average amount of family cooking.

Several good sources for comparative fuel costs are listed in the back of the pamphlet, and can be put to good use by the gasman located in an area where electric competition presents a serious problem.



A general layout of Operation Cue's Survival City. LPG and piped gas installations at the 4700-ft mark withstood the blast well. Two gas utility trucks at the 15,000-ft mark came through the test unscathed. Regulator pits and domestic gas meters were operative immediately after the bomb was touched off.

How gas survived the A-bomb test

By **HAROLD C. HOOD** • Field Editor

"OPERATION CUE" in Yucca Flats, Nevada, presented piped gas and LPG with the most severe test of their history. Underground utility gas pipe within 1500 ft of the 500-ft shot tower, and L. P. gas storage plants and domestic installation, one of which was 1840 ft away, were exposed to the violence of this largest of all A-bombs. Some of the gas appliances were actually in operation at the time of the blast.

"Paralyzing, terrifying thunder—like a crashing fulmination of hell—smashed into our Patton tank with a single lash of demoniacal rage." This is how Marvin Miles, an eye-witness reporter and member of the *Los Angeles Times* staff, described the fury of the 35-kiloton A-bomb blast on May 5. Mr. Miles braved the blast at the 3100-yd mark in one of 55 50-ton Patton tanks in the Army's Task Force Razor, which rumbled toward ground zero three minutes after the first blinding flash of the bomb.

GAS staff report

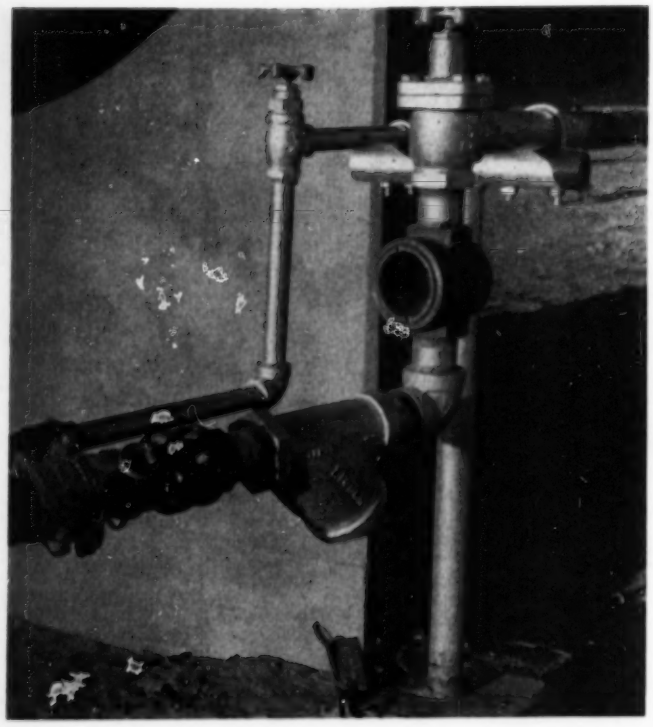
Joint test

The test was conducted jointly by the Federal Civil Defense Administration and the AEC for the purpose of determining the amount of havoc that would be wreaked by an enemy A-bomb attack on an American city. Another important reason for the test was to learn how effective various protective measures actually are in the face of a real atomic explosion. Manufacturers of all types of motor vehicles, house trailers, gas and electric utility equipment, and other commonly used items participated by furnishing equipment to be used in the test.

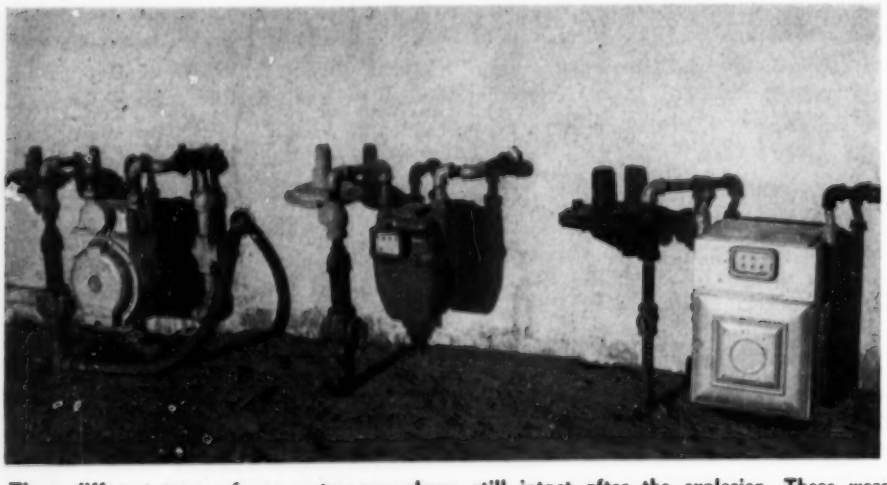
"Survival City"

The dummy town, built to simulate conditions in any vulnerable American city, was dubbed "Survival City," and contained buildings and installations situated in such a manner that various degrees of bomb damage could be studied.

This utility gas equipment, located behind one of the concrete homes at the 4700-ft line, withstood the force of the bomb blast.



Piping and fittings connected to the 18,000-gal. LPG tank at the 4700-ft line are shown after the blast. No damage was done to piping. The only casualty in this LPG installation was the railing and a rung of the ladder at the top of tank.



Three different types of gas meters are shown still intact after the explosion. These were mounted on the back of one of the concrete buildings at the 4700-ft mark.

Many projects, identified by number, were set up to study the effects on particular classifications of equipment. Civil Effects Test Project 35.4, industrial and domestic gas storage and distribution, was set up for the purpose of testing all aspects of gas usage under atomic explosion conditions. Project 35.4a was concerned with LPG, while Project 35.4b dealt with natural and manufactured gas. The former was sponsored by the LPGA and its member companies in cooperation with the FCDA. Project officer was Paul W. Tucker of Phillips Petroleum Co., assisted by G. R. Webster, Pyrofax Gas Co.

Sponsorship

The natural and manufactured gas project was sponsored by the AGA and its member companies also in cooperation with the FCDA. The leader of this phase of the test was Guy Corfield, Southern California Gas Co. The two segments of the industry worked closely together in preparing test equipment. Propane, for example, was used in utility-type pipelines laid near the shot tower because of the lack of a supply of natural or manufactured gas.

The premise under which the LPG tests were conducted was, in the words of the FCDA, that "knowledge of the effects of a nuclear explosion on typical liquefied petroleum gas equipment installations is necessary in planning post-disaster civil defense operations because of the importance of having available such equipment for emergency uses following a nuclear attack."

To attain this knowledge, installations of 100-lb bottled gas cylinders and

Roger Johnson of Carl Byoir & Associates, holds up the wig which was hurled from the head of the mannikin to the top of the undamaged gas refrigerator in the background.

A-bomb . . . Underground facilities withstood the shock wave

500-gal. ICC gas containers were tested at four different locations, each site being at a different distance from the blast. Typical LPG equipment was installed in accordance with normal domestic and commercial practice in several of the buildings erected for Operation Cue. All tanks were partially filled, and live gas was furnished to appliances in one of the buildings.

An LPG distribution and storage station was installed at a point where substantial damage to aboveground structures was expected. Included in the station was an 18,000-gal. storage tank mounted on concrete saddles, a pump, a distribution building housing charging facilities and cylinders, and associated piping and controls. Moments after the blast the building disintegrated. The storage tank, however, remained intact, the only damage being a bent rung on the ladder.

Civil defense authorities who went into the damaged area after the A-bomb explosion reported that the town's other liquefied petroleum gas systems suffered only superficial damage. In seven of eight tanks tested, volatile fuel remained intact and usable. In the eighth tank a valve had been sheared off and the gas had escaped. All of the eight cylindrical tanks had been moved from their original positions by the force of the blast.

4700-ft mark

The LPG station was located at the 4700-ft mark along with four other test buildings on "Doomsday Drive." Two of the other structures shared the fate of the station. One of these, a two-story masonry house, spouted billowing smoke from inside moments before it caught the full force of the shock wave and flew apart in every direction. This dwelling had been constructed of one layer of brick backed by a 4-in. wall of cinder block, and was typical of many homes throughout the nation. Wax dummies inside the building, representing an average American family, were badly mutilated.

Also completely destroyed by the atomic holocaust was a single-story frame rambling house without a basement. This was similar to many modern one-story frame homes built on a concrete slab, except that the bathroom was constructed with reinforced concrete walls and ceiling to serve as a family shelter. Only the reinforced bathroom survived the blast.

Two of the homes on this residential street managed to remain intact, and suffered only blown-out windows, flash burns, nicks from flying debris, and interior damage. One of these was constructed of 8-in. masonry blocks, steel-reinforced. The other was made of precast, expanded shale aggregate concrete.

Power lines on the ill-fated drive did not fare so well. Lines drooped to the ground, and five of the 15 power-line poles were snapped near the ground. The other poles were charred and splintered.

Natural gas

Project 35.4b, closely tied in with the LPG project, was conducted because "the extent to which natural and manufactured gas utility installations may be disrupted in the event of nuclear explosions is of considerable interest to civil defense authorities, since such installations represent one of the basic utility services. This project is designed to obtain information on the effects of blast pressure on critical underground units of a typical gas distribution system."

Installations comprising valve pits, regulator vaults, and 6-in. gas piping in trenches both normal to and parallel to the direction of blast were made at two locations where different degrees of damage were anticipated. The pipe installations included both cast iron and steel sections with appropriate fittings and various types of service connections.

Also installed were service lines of steel, copper, and plastic material, which were connected to the residential-type houses constructed for the project. Both rigid and flexible sections through building walls were tested. Typical domestic gas appliances were located in several buildings, and live gas was used in only the brick house.

The AEC, in its preliminary evaluation of the results of the LPG project, reports that the project officer had the following to say regarding his observations within the first hours following the shock:

"Preliminary evaluation indicates that the liquefied petroleum gas bulk tank (at 4700 ft) sustained only superficial damage from the blast. It was confined to the ladder, the railing, and the walkway around the top of the tank. All valves and piping were intact. No gas was leaking, and the entire contents of the tank—15,400 gal. of LPG—remained available for use. The cylinder filling building was destroyed, although the piping to it was not damaged. The transfer facilities—a liquid pump and a vapor compressor—also appeared undamaged. The plant could quickly be put back into operation for emergency use by employing a small bulk delivery truck to do transfer operations and cylinder filling until electric power lines were restored to servicee. In fact, for most uses, the gas in the storage tank would be available by taking advantage of gravity flow plus the inherent pressure of the gas itself."

He reported that no LPG containers in the entire area were ruptured. Even those located at the 1840-ft and the 2750-ft lines suffered only minor damage. Both of the 500-gal. tanks at these two forward locations still had their gas contents available for immediate use.

Seven of the eight cylinders used in the test were likewise available for service, although they were displaced somewhat from their original positions. The eighth had its valve sheared off by the impact. The major damage to the tanks was occasioned by the blast itself rather than by flying debris. Thermal damage was nonexistent. There was no evidence of fire.

Availability of fuel

The test indicated that L. P. gas will be available as a fuel when exposed to atomic effects of this degree of severity. The test also indicated that where a house remained intact the LPG equipment was salvable and ready for use with minor repairs.

In the natural gas and manufactured gas tests of Project 35.4b, the project officer, Guy Corfield, reported the gross effects observable within the first hours after the blast. He found that preliminary evaluation showed that underground piping, valve pits, and regulator vaults at the 1470-ft and 4700-ft lines

Within a few minutes after the 35 kilotron bomb was set off, observers were served LPG-cooked breakfast on "Media Hill." All present agreed that LPG is an ideal "disaster" fuel.

Emergency feeding exercise proves "disaster" value of LPG

FIFTY minutes after Operation Cue's 35-kiloton atom bomb had been touched off, an "atomic" breakfast was served to 1200 people with the aid of bottled gas. The mass feeding practice was part of the Atomic Energy Commission's civil defense operation.

Breakfast consisted of orange and grapefruit juice, scrambled eggs, scrapple, bacon, rolls, marmalade, coffee, and milk. Within 20 minutes after the shot was fired the meal was ready to be served. Quickly moving lines of newspapermen, television representatives, AEC and civil defense personnel, and official observers from all parts of the country were served without a hitch.

The breakfast was prepared and served by a group of 60 persons, composed of volunteers from all over the country, working through the Federal Civil Defense Administration's National Advisory Committee on emergency feeding. Each member of the group is a professional in his own field. The group represented professional associations and companies that are cooperating with civil defense in planning emergency mass feeding following atomic attack.

The meals prepared and served by this group are comparable to meals that would be given to casualties and evacuees following an attack on cities, provided the foodstuffs are available. Food supplies would, of course, depend upon local situations.

GAMA and the LPGA played important roles in the mass feeding exercise. Members of LPGA rushed in supplies of gas in portable tanks just before serving time. GAMA representatives were on hand to connect the fuel lines to the utility gas cooking appliances, and help with the preparation of the meal.

Because of unfavorable weather conditions, firing of the shot was postponed nine times. Observers, however, were on duty at "Media Hill" and other assigned posts before each postponement. Heavy coats, caps, and gloves did not always provide sufficient protection from the cold desert night air, and coffee brewed on LPG-fired ranges was heartily welcomed by the observers.

In one test run before the blast, GAMA and LPGA trucked tanks of LPG into the observers' area, connected fuel lines, and had coffee ready for newsmen and TV representatives within 12 minutes.

The day following the firing of the bomb the mass feeding teams set up facilities in the forward area. Lunch for all observers studying the results of the blast was prepared using cooking equipment made of rubble from damaged structures and converted appliances taken from the test homes. The menu consisted of tomato juice, roast beef served with a roll, beef vegetable stew, baked beans, fruit, coffee and milk, and dessert.

Results of the practice—everyone who witnessed the meal preparation agreed that bottled gas is an ideal "disaster" fuel because of its portability and adaptability to standard gas appliances.

A-Bomb . . . Meters and regulators on sheltered side were undamaged

were apparently undamaged with the exception that the aboveground 4-in. vent pipes of the regulator vault at 1470 ft were snapped off at ground level.

Pipe, buried 3 ft in the ground, was undamaged. Valve pits and vaults had cast iron covers at ground level which were slightly displaced by the impact at 1470 ft, but were unmoved at 4700 ft.

The service piping to houses at the 4700-ft and the 10,500-ft distances, and the house meters and regulators outside the east walls of the one-story pre-cast slab houses apparently were undamaged. Appliances in the slab house at 4700 ft (range, water heater, and room heater) were slightly damaged but usable. The refrigerator door and top were badly dented.

In the two-story brick-faced home that was destroyed (4700-ft mark), the appliances (refrigerator and range) which were located on the first floor were badly damaged and apparently unusable. The water heater and the clothes dryer in the basement of this house were undamaged. The gas refrigerator, and the meter attached to the basement wall were torn apart at the piping connections and were lying on the ground, but probably would be usable when repiped. House piping in the basement was torn away from the ceiling nearest the west wall.

Appliances operative

The refrigerator, water heater, and room heater in the one-story slab precast house at the 10,500-ft line were apparently undamaged and were immediately reusable. The only thing that happened to them was that their pilot lights had been extinguished.

Eyewitness T. T. Arden, president of GAMA, in commenting on Operation Cue, stated that while some valuable information was obtained from the tests regarding gas appliances, no general conclusions as to how to install them to safeguard them from atomic attack had been drawn. The bomb used in Operation Cue was only of 35 kiloton rating, Mr. Arden pointed out, and appliances that had come through unscathed in the test might be completely destroyed if subjected to a hydrogen bombing. ■

Wisconsin Public Service holds with the PR rule that "what employees think and say about their company carries more weight than any other single method of publicity."

Employees rewarded for good relations with the public

By C. B. **BOULET, Director of Personnel** • Wisconsin Public Service Corp., Green Bay

"Presto"—Good public relations—

THAT'S what the man said. He said, "Good public relations is a state of mind. When the state of mind of all the people associated with a company is favorable, then—Presto—you have good public relations."

Okay, go ahead and object, you public relations experts. Point out that the exciting story of your company needs to be dramatized in institutional advertising, press releases, booklets, films, radio and television programs, visitor days, and all the other accouterments of your profession. And yet you will probably agree that all the tools your agile minds can devise aren't worth a hoot without employee backing. The cardinal principle of public relations still remains—"Good relations must begin within the organization. What employees think and say about the company carries more weight than any other single method of publicity."

Utility companies recognize that fact. They have attempted to condition employees to tell the correct story by subjecting them to a barrage of training programs. And the programs have been good. Many organizations have developed their own films, speeches and booklets in an effort to impress on their people the rudiments of good customer and public relations.

That type of program is essential. Employees should know answers to questions that customers might ask. They should be aware of erroneous conceptions held by the public. They should have schooling on the best way to approach customers, to placate customers, and to solve customers' problems. It is helpful to have employees know about rates and policies pertaining to delinquent accounts, merchandising, dealers, right-of-way, service charges, home calls and the million and one other items that are a part of the business. But even if an employee were able to absorb and disseminate all of that information, one more thing is needed. For lack of something better, let's call it "state of mind."

Henry A. Overstreet in his book, "Influencing Human Behavior," says, "Action springs out of what we fundamentally desire . . ." Personnel men long ago came to the conclusion that . . . "the most important factor in employee effectiveness and morale was the mental outlook of the individual." Wise men, through the ages, have made the same observation in many different ways.

Why not, then, devote some talent and energy toward creating the desire to do a good customer relations job? Why not use an adult approach and recognize that people who work for utilities can be pleasant, courteous, sincere and informed? Why not recognize that most bad customer experiences occur because some member of our organization didn't particularly care about doing an outstanding job? Why not believe that the employees we hire are top-flight and know the fundamental techniques for handling people and only need the proper inspiration to live up to their capacities?

It can be done. We all have some employees who inconvenience themselves to create that warm glow of favorable opinion about our companies and our industry. We have people who, without any prodding, gladly go "the second mile" with customers. We have people whose entire attitude says, "You—our customer—expect the best and I'm proud to accept the obligation to give it to you." Why is it that only some of our people have a real affection for rendering good service? Why is it that some utilities have developed that personality more than others?

An examination of those organizations whose employees have an awakened spirit of service reveals that it didn't just happen. Most of them have had a clearly defined program. Most of them, with much forethought, have been traveling the road to good public relations in all their training programs and communication media. A review of their activities might be interesting.

Practically all of those companies whose employees put out extra effort customer relations-wise have what might be termed "report meetings." These are sessions attended by employees and their wives at which a high company official, often the president, reports on the state of the company. In addition to discussing the company's financial situation, employees are informed of proposed plans, programs and problems. Conditions that particularly affect the wage earner group are brought into the open and carefully scrutinized, whether they be encouraging or discouraging from the employee's point of view.

The objective of such meetings is to give employees the feeling of belonging—of being a partner in an enterprise. Questions they might have concerning the company's operations are truthfully answered. Opinions of employees on the proper solution to company problems are solicited. This exhibition of sincere

interest in employee problems and opinions builds a faith and belief in their organization that readily translates itself into a desire to build the business.

Another program utilized by the more public relations conscious companies exceeds provincial bounds. These progressive companies recognize the threat of socialism to the utility industry and make sure their employees also know what might happen to their economy and their company should the trend continue. These companies take heed of the warning issued by Robert E. Ginna of the Rochester Gas & Electric Corp. wherein he said, "It is an obligation to ourselves—and it is certainly a duty to our customers, therefore—that we should support and participate so far as possible in those activities of our industry which help to secure the future and protect us against insidious forces destructive of our hopes and plans."

The companies that have done the best job along these lines devise programs that show how the national picture can affect their organization and their employees. The subject matter is usually first presented in employee meetings by means of films, charts, maps and other visual aids. Recognizing that the battle is a continuing one, they utilize all methods of communication to keep employees informed and to encourage their support. House organs, reading racks, bulletin boards, and special mailings to employees' homes are used to supplement regular information programs.

One method that has drawn much favorable comment is the presentation of annual awards by Wisconsin Public Service Corp. to the three employees in the company who, "through uniform and patient courtesy, and original and unselfish acts in order to better serve customers, have contributed most to the betterment of public relations." The competition, named after its originator, C. R. Phenicie, retired vice president of the company, is open to employees below the supervisor level. Mr. Phenicie annually contributes a trophy and savings bond to the winner. Cash awards are made by the company to the three winning employees.

Data sheets are completed for each candidate which require answers to some very probing questions. Weighed heavily in determining the winner is the attitude of the individual in giving freely of his own time to further the company's interest and to assure the customer of the best possible service. Other factors include job performance, courtesy, promotion of company products and services, participation in company and community activities, cooperativeness and customer satisfaction. It is interesting to note that winners of these coveted awards are generally people who have gone to extreme lengths to satisfy customers at considerable inconvenience to themselves.

The first place winner in the last annual contest was commended for his poise, objectivity, friendliness and understanding. The data sheet accompanying his entry cited many instances of his loyalty and unselfish devotion to the problems of the customer. His supervisors reported the many suggestions he offered to improve service and establish a friendlier relationship with customers.

C. E. Kohlhepp, president of Wisconsin Public Service, which pioneered this type of contest, says this about the activity: "We feel that through the external, internal, and word-of-mouth publicity the award receives each year, our people discover that many little things they do to better serve our customers are recognized by management. The award and attendant publicity stimulates all of us to strive for public good will in all of our activities." ■

AGA commends WPS for its program

Last year's winner of the C. R. Phenicie award is Howard Johnson (left). Reading his data sheet is W. H. MacDonald, Green Bay division manager.

"Wisconsin Public Service Corp.'s C. R. Phenicie PR award for employees is the model for similar contests started by several other utilities. This pioneer contest is an effective and inexpensive goodwill builder — tailormade for small as well as large gas companies," says the AGA public information bureau's Intercom Special Report.

Qualities that highlight winner's data sheets include:

Has an unusually pleasant way with people . . .

Never overlooks an opportunity to sell the company to the public and to promote major appliance load . . .

Goes out of his way to help people . . .

Stops during his noon hour to meet customer at a specified time . . .

Never loses his poise; is a good listener . . .

His loyalty and honest effort in giving his best without seeking recognition or praise have made him an outstanding employee . . .

Mild mannered and very patient with irate customers . . .

Goes beyond normal requirements to explain to customers on high bills or other rate questions . . .

Never rushes through an interview with a customer . . .

Is always given the tough problems to handle because of his tact and understanding . . .

Never antagonizes customers and has a knack for getting customers to see and understand the right solution to their problems . . .

Is very cooperative with everyone in his department and in all other departments . . .

Time means nothing to him when a customer's problem is involved . . .

The Koppers-Hasche reformer

Principles of operation and estimated costs

By G. V. McGURL
and G. L. FLEMING
Koppers Co. Inc., Pittsburgh

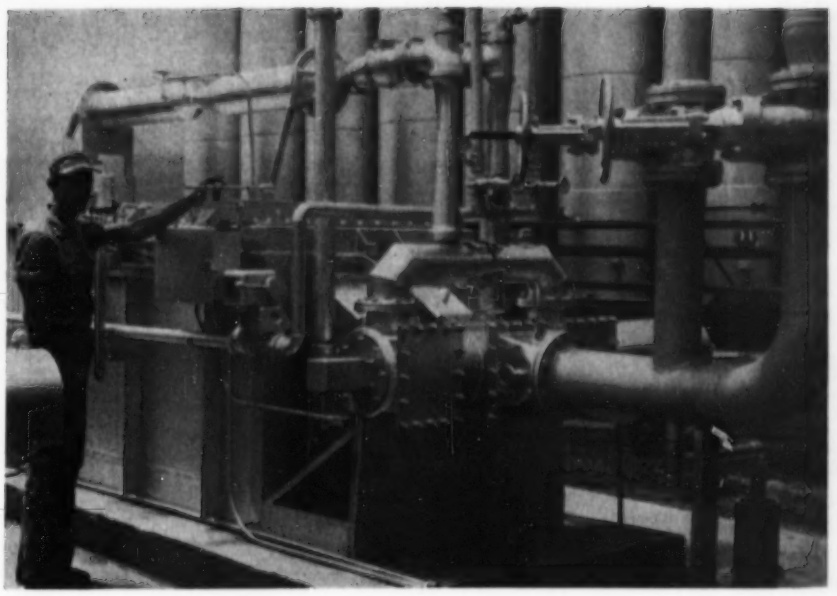


Fig. 1 is a complete reformer installation with a 1 MMcf per day make-gas capacity. All the control instruments, the cycle timer, etc., are mounted on the side of the unit (in the enclosure beneath the operator's arm). The operator is adjusting the air-slide valve, which controls the heating value of the make-gas. This is the only adjustment required for operation. Once set, it requires very little subsequent attention. In the right foreground is shown the reversing valve and injector. The reformer operates equally well when using propane, butane, or natural gasoline as feed stock, and produces a sendout gas varying in heat content from 530 Btu to over 1300 Btu.

A DIRECT, low-cost answer to base load, peak load, or standby problems of the gas industry is found in the Koppers-Hasche reformer. It is a self-contained gas plant for reforming propane, butane, natural gasoline, or any mixture of the three, for the production of gases, interchangeable with carburetted water gas, oil gas, or natural gas.

This reformer consists essentially of two highly efficient regenerators, separated by a combustion chamber. These regenerators are formed by stacking special patented tile,* made from high-grade alumina. When these tiles are laid face to face, they form regenerative masses with the channels, in the tile, matching to form a number of small parallel flues that extend throughout the length of the regenerative masses.

One of the exclusive design features of the Koppers-Hasche reformer tile is the dimensional relationship between the flue areas and the surrounding refractory mass. Dimensions and design of the flues are such that the tiles store and release heat at the optimum rate for uniform production of reformed gas, maximum cold gas efficiency, and maximum reclamation of Btu's or heat input.

Fire brick and insulating brick surround these regenerative masses to minimize heat losses. All the refractories are enclosed in a steel shell, the temperature of which, at the hottest point, does not exceed 200° F under normal operation.

One or two injectors inspirates a small amount of primary air with the hydrocarbons to be reformed, and a four-way reversing valve controls the direction of flow of gases through the furnace.

An estimate of the costs of operating a Hasche reformer would begin with an analysis of feedstock requirements, as shown in *Fig. 3*. These may be readily converted to cost of hydrocarbon feed per 1 Mcf of sendout gas. Other operating costs will include:

1. One operator per operating shift. This operator spends only a small portion of his time checking the reformer operation, which leaves him ample time to unload the LPG shipments, to operate the sendout gas compressors, and to perform general maintenance and housekeeping duties.

2. Actual plant operations have shown that the maintenance and repair costs for the entire installation will amount to approximately one cent per 1 Mcf of make-gas.

3. Utility requirements per 1 Mcf of make-gas are limited to approximately 65 gal. of 70° F cooling water and 1.5 standard cu ft of compressed air for the reversing valve operation. Only a small amount of 110-volt electricity is required for the timer and feed pump operation.

Experience has shown that all operating costs other than fuel will not exceed five to six cents per 1 Mcf of make-gas. With propane at seven cents per gallon, the raw material cost amounts to 42 cents per 1 Mcf when producing

*U. S. Patent 2,622,864.

This article has been adapted from a talk presented before the operating division of the NEGA in Hartford, Conn., Nov. 4, 1954.

Flow diagram of the reformer

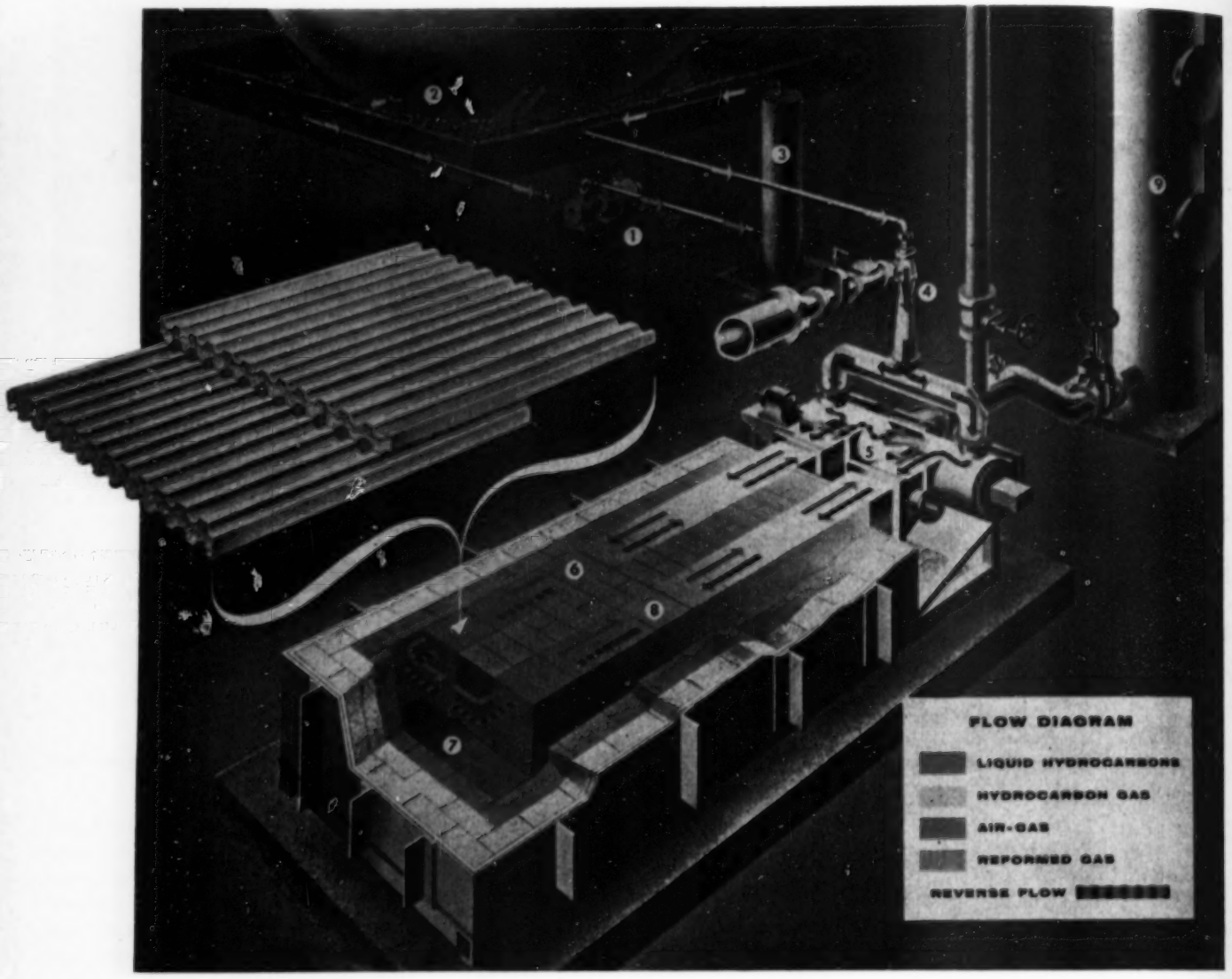


Fig. 2. Flow diagram illustrates the construction of the reformer and the flow of materials through a typical installation. The liquid hydrocarbons to be reformed to a base load, peak load, or standby gas, are transferred by pump (1) from storage (2) to the vaporizer (3), where the hydrocarbon liquid is vaporized.

Leaving the vaporizer, the hydrocarbon gas, under pressure, passes through a venturi injector (4) where a predetermined amount of air is inspirated. This air-gas mixture, which is on the rich side of the explosive range, then flows through the four-way reversing valve (5) into one of the regenerative tile masses (6) of the reformer.

In passing through this tile mass, the air-gas mixture is preheated, and as it enters the combustion chamber (7) the air content reacts with part of the hydrocarbon to supply the heat necessary for cracking and reforming. The heat thus liberated maintains the proper cracking temperature in the unit so that no external heat is needed beyond that required during the initial heating period.

From the combustion chamber, the reformed gases pass through the second regenerative tile mass (8) where sensible heat is extracted. The cooled gases leave the reformer through the four-way reversing valve (5) and are piped to the gas cooler (9) for final cooling before distribution.

At regular intervals, the direction of flow is reversed so that the gases enter through tile mass (8) and leave through tile mass (6), thus utilizing for preheat the heat stored in regenerative mass (8) during the previous cycle. By this means, the utilization of the heat stored in the regenerative masses results in an over-all cold gas efficiency in excess of 95%. Only one control, the amount of air inspirated by the injector, is required to change the heat content of the reformed gas over the entire range of 530 to 1300 Btu.

Also shown is a view of the patented tile and the mode of stacking to form the regenerator. Note that the gas passes through the tile banks in small-diameter circular flues. Gas velocity is high, permitting a good heat transfer coefficient between refractory and gas. The ratio of gas passage to tile area is especially designed to prevent damage to the tile due to rapid change of temperature. After three years operation, there is no sign of deterioration.

Koppers-Hasche reformers...
Some 20 units are in operation throughout the country

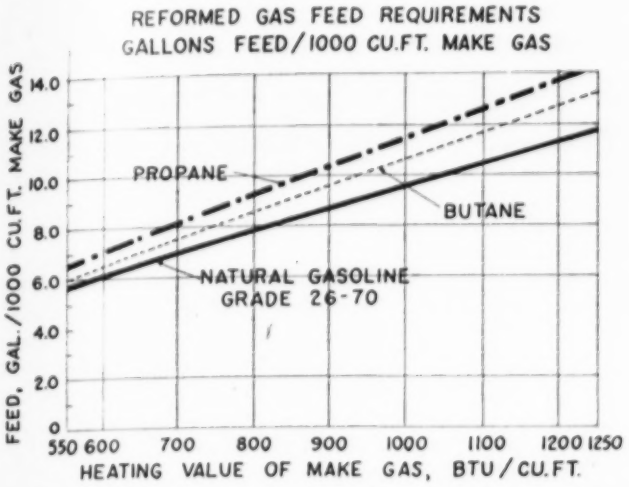


Fig. 3. Raw materials in gallons of propane, butane, or natural gasoline (grade 26-70) required to produce 1 Mcf of sendout gas. Heating values of the make-gas are shown at the bottom. The feed requirements shown are gross values, and no additional fuel will be required by the reformer to produce the make-gases as shown.

Many formulae and test burners have been devised to assist in evaluating the interchangeability of gases. In addition to using available formulae, it is Koppers practice to produce and burn the gases for any proposed installation in appliances having burners characteristic of those used in the community, and adjusted accordingly to be certain that the reformed gases will actually burn satisfactorily.

Actual experience and plant-scale tests have proved that propane reformed in a Koppers-Hasche reformer to about 630 Btu per cubic foot with a gravity of 0.84 will replace carburetted water gas with a heating value of 570 Btu and a gravity of 0.72.

Large proportions of reformed gas with a heating value approximating that of the natural gas may be mixed with the natural gas. If necessary, complete replacement of natural gas may be attained by increasing the heating value of the reformed gas to a value 100 to 150 Btu higher than that of the natural gas.

a 530-Btu gas, or a total of 48 cents per 1 Mcf of make-gas at the gas cooler.

The first commercial reformer used for the production of heating gas was put into operation in January 1951 in Johnson City, Tenn. Originally, this unit produced base load gas interchangeable with a 900-Btu propane-air mix. However, the heat content of the reformed gas was gradually increased to approximately 1100 Btu prior to the distribution of natural gas. Gradual conversion to 1100 Btu was handled by the company's service personnel. Final conversion, in March 1954, from reformed gas to natural gas was made successfully with a few minor burner adjustments. This reformer is now maintained in standby service.

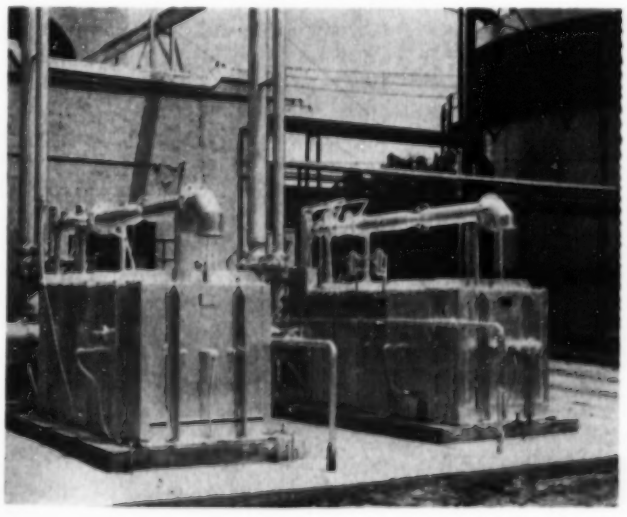
Another installation at Kinston, N. C., has recently been equipped with controls to permit completely automatic operation based on service demand.

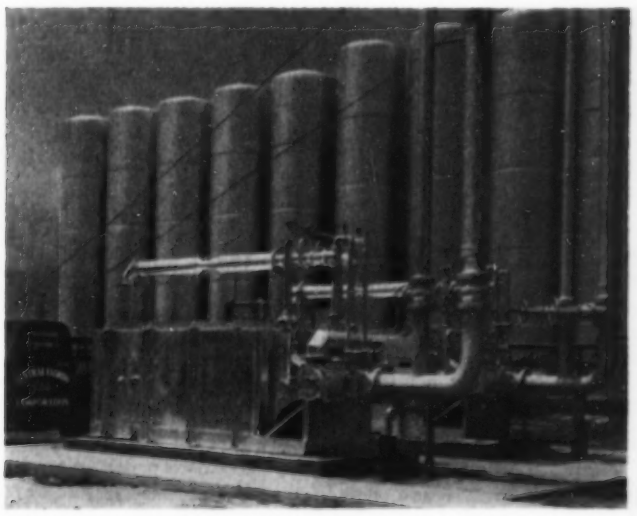
At North Miami, Fla., another unit produces a reformed gas from propane with a heat content of 709 Btu that is interchangeable with a 709-Btu oil gas-air mix. An additional reformer has been projected to meet increased peak load requirements.

All told, some 20 units are now in operation throughout the country.

The Koppers-Hasche reformer is the result of many years of experimental and developmental work in the field of thermal cracking of hydrocarbons by Dr. R. L. Hasche. Dr. Hasche and Koppers Co. have entered into an exclusive agreement for the sale of reformers for the production of heating gases. The Hasche Engineering Co. of Johnson City, Tenn., handles the sales of reformers of limited size in nine southern states, while Koppers Co. Inc. handles all other domestic and foreign sales. The reformer is known as the Koppers-Hasche reformer or the Hasche reformer. ■

Views of Central Florida Corp.'s installation.





GAS reviews

Conferees at the recent AGA research and utilization meeting were outspoken in their concern over the new improvements in competitive equipment that threaten to diminish the inherent advantages of gas. In addition to the improved electric water heaters (see pages 50-52), new electric ranges and even resistance heating units pose real threats to the supremacy of gas.

The impact of oil and electricity on the gas househeating load

Gas today has two competitors worthy of serious concern in the househeating field—oil and electricity. While only the former is well established, the latter is posing a threat to the future.

The impact of the two fuels on the gas househeating load was effectively appraised by H. F. Carr, Baltimore Gas & Electric Co., at the AGA research and utilization conference. Space permits the publishing of only a portion of Mr. Carr's address, forcing the omission of some pertinent details on a gas-v.-oil heating argument in Baltimore.

DURING the past few years, the oil industry has made improvements in fuel oil and burning equipment. A few of the most important are the starting of the blower motor prior to the flow of oil, the replacement of ceramic combustion chambers with metallic ones, and the chemical additives that are mixed with the oil in order to prevent sludging.

The starting of the blower motor prior to the flow of oil has cut down the speed of sooting up and thereby increased the efficiency of the heating plant, but certainly not more than a few percent.

Combustion chamber

The change in the combustion chamber materials consists of very light brick, which has advantages over heavy dense brick in that it comes up to temperatures quickly, and stainless steel liners, which come up to temperature quickly and reflect back radiant heat into the oil stream, thus reducing the time during which oil may not burn cleanly. The disadvantage of these metal liners is shorter life. Any step to reduce the mass of material that must be heated is a step toward reducing overall standby loss.

The oil additive compound prevents oil sludging and combats corrosion in oil tanks. This development would tend to hold up the efficiency of the original installation by allowing a constant amount of oil to flow through the nozzle, thereby maintaining the proper mixture of oil vapor and air.

It is a well-known fact that the adjustments on an oil burner using less than three-quarters of a gallon of oil per hour are very critical. The nozzles are small and any change in the density of the oil throws the combustion mixture out of balance. A large percentage of the homes today are below the three-quarter-gallon-per-hour demand.

Yes, improvements have been made, but I shall quote from the *National Petroleum News* of March 3, 1952:

"Oil burners generally operate at 45 to 55% efficiency."

"A testimony to service inefficiency."

"Most installations result in low thermal efficiency."

"While the impact of electric heat in our area has been negligible, it is a recognized fact that the popularity of this form of heating is increasing regardless of the cost of the fuel," said H. F. Carr.

"By comparison, due largely to AGA's high standards and their laboratory work, gas heat burns with a low stack temperature and CO_2 is at an almost constant figure. So studies show it is not unusual to find a gas installation averaging 70 to 75% thermal efficiency."

While the impact of electric heat in our area has been negligible, it is a recognized fact that the popularity of this form of heating is increasing regardless of the cost of the fuel. The peak load demands of many electric utilities have changed from wintertime to summertime because of the extremely heavy air conditioning load. In order to offset this summertime peak, some utilities are promoting resistance heating and with some degree of success.

Typical example

A typical example of this is Cleveland Electric Illuminating Co., which has a high saturation of both gas and oil burners with gas predominating 12 to 1. In metropolitan Cleveland, 560 homes are completely heated with electricity and at a rate that does not go below 1.7 cents per kwh. The cost of operation is practically three times the cost of oil and the differential is greater when compared with gas. According to an article in *Fuel Oil and Oil Heat* magazine, this electric heating load has come to the utility with very little effort, as on its first applications for home heating the electric utility tried to discourage people because it was afraid that high fuel bills would bring grief to both the user and the utility. Recently, it has done some selling and expects to do more this fall.

You would normally surmise that people living in these homes had no concern as to costs. On the contrary, according to a utility representative, all of these homes are small having as little as 1000 sq ft of floor space. Fuel bills are kept within a range that the family can meet by insulating the houses so thoroughly that they are

practically thermos bottles. The cost to heat these same houses would be much less with gas or oil. It seems that the users are interested more in a price that they can afford to pay than they are in a low-cost operation.

Small houses designed for electric heating are usually built without chimneys thereby saving approximately $250 in construction costs. However, the cost of insulating, storm windows and doors amounts to between $250 and $300, thus offsetting the chimney saving. The gas heating equipment for a 6-room house, with a 45,000-Btu per hour heat loss, would be approximately $480. The same house, designed and insulated for electric heat, would have a heat loss of between 25,000 and 30,000 Btu's per hour and the cost of the thermostatically controlled heating panels and wiring would be approximately $500. So there is very little difference in either the cost of building or heating equipment.

"Most modern fuel"

Those promoting electric heating bring out the fact that it is the most modern fuel since the user has individual temperature controls in every room and that it is the cleanest of all fuels. There are approximately 300,000 homes in the country electrically heated. Most of these are in the TVA territory or the Pacific Northwest. A surprising number keep popping up in high cost electricity areas. *Certainly these are object lessons to folks who think you can't sell anything unless it is cheap.*

Whereas gas and oil heating costs work out close to theoretical calculations, studies of actual installations of electric heat show that these heating costs work out to less than the theoretical computations. This is undoubtedly because most electric heat is of a radiant type and the room temperatures are lower than those carried by the convection type of heating. Another factor is that each room carries its own thermostat and most users realize that they are using a luxury fuel and consequently regulate the thermostats in order to keep the cost down. This is the old story of the gas range versus the electric range. The average housewife turns on the gas burner and "lets her go," but give her an electric range and she invariably turns it to lower heat when boiling begins.

Most electric utilities are taking a good look at their rate structure and as electric househeating grows, many will be forced to raise their rates for heating as their lowest rate step was not designed to take care of high capacity intermittent loads.

The new operating features of domestic electric ranges

As is obvious to those who are thoroughly familiar with domestic ranges, gas models are far superior to electric models. The electric industry is not napping, however, but is diligently working to overcome the inherent advantages of gas ranges. Some of the new features being built into electric models are features that gas ranges have always been able to boast of having.

In a special survey of "The New Operating Features of Domestic Electric Ranges," which he presented before the AGA research and utilization conference, Walter F. Hagman of Globe American Corp., Kokomo, Ind., listed five technical advancements in electric range design.

THE first is the high-speed heat-up switch for top surface cooking. The essential feature of the switch is the connection of a 120-volt surface unit to a 240-volt supply source, which produces four times the normal wattage. At the end of 30 to 35 seconds, a bimetal trip mechanism (heated by the current in the wire) reconnects the 120-volt unit to the normal 120-volt source.

Infinite heat switch

This feature is usually combined with the infinite heat switch and the combination of the two usually costs a consumer about $10 per surface unit. For this reason, many of the electric ranges have only one surface on the range so equipped.

This is a very desirable feature; however, it is something that every gas range has featured on every burner since gas was first used as a cooking fuel.

Gas burners also have one additional advantage—a quick turndown. Just try it with an electric surface unit. You will find that after the vessel reaches cooking temperature and the switch is turned down, the temperature continues to rise, because of the fly-wheel effect that is inherent in the design of electric heating elements.

This electric range feature does, however, present a challenge to the gas industry to continue to improve its burner for a quick start in order that we can stay ahead of our competition.

The second item in the advances of the electric range industry is the mechanically and thermally operated infinite heat switch, which is usually combined with the quick heat-up switch. The mechanical infinite heat switch employs a cam which is rotated at 1 rpm by an electric clock-motor. This cam opens and closes electric contacts in the surface unit circuit, thus turning the unit on and off continuously. When the switch knob is turned to a high heat, the cam-operated contacts move closer together so that cam keeps these contacts closed for a greater part of the minute cycle. When the knob is turned to a low heat, the cam-operated contacts separate, thus keeping the surface unit shut off for a longer time.

Desirable feature

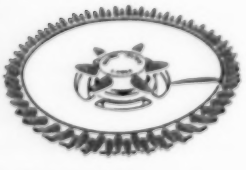
The thermally operated infinite heat switch operates identically to the mechanical, except that heat from the current in the wires operates a bimetal strip, which opens and closes the contacts in the surface unit circuit. The infinite heat switch, either mechanical or thermal, is then an infinite position switch, identical in operation with an ordinary gas valve. Again this is a very desirable and expensive feature, and again it is something that the gas range has featured since its beginning.

Sometimes I think we in the gas industry are under the spell of all electric range advertising, as now we are talking of a valve that will enable us to number certain positions on our valve handle so that we can get certain fixed positions in the setting of our top burner. I think this is just what our competition wants us to do, so that they will no longer have to defend their 5- to 7-position switch that is now being used on the greatest percentage of the electric units. In any case, it seems to me that the gas and electric range industries are moving in opposite directions in developing surface-unit controls. I think to keep ahead of this new electric feature we should encourage the use of the valve designed by the AGA Laboratories and which is now available through some of our valve manufacturers. This valve has a greater angular rotation from off to full

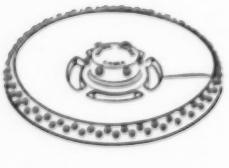
(Continued on page 68

ALLTROL® CENTER make GAS RANGE

ONLY ALLTROL® BURNERS GIVE THRIFTY MEASURED HEAT

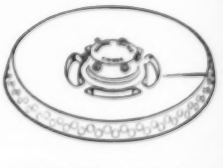


Instant full flame... brings foods to cooking temperature in shortest time.

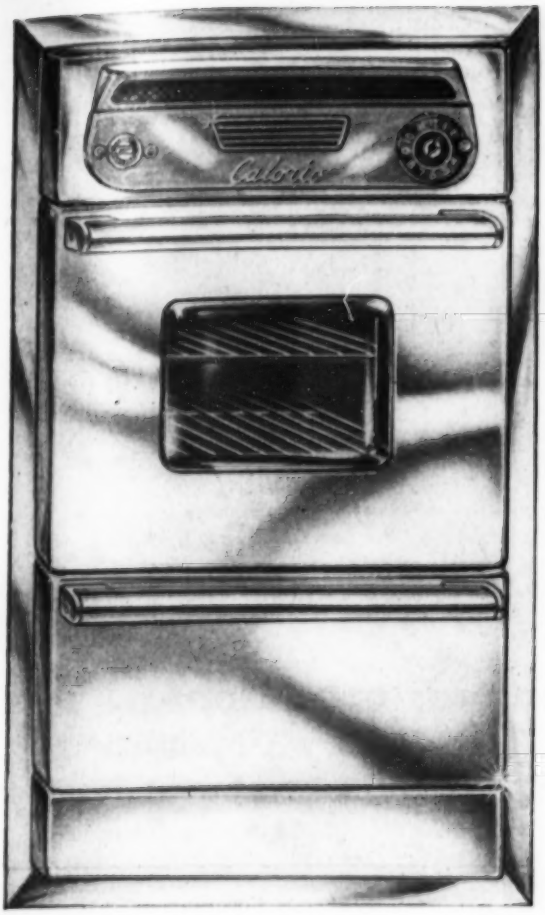


"Click"... convenient Low Frying heat... provides perfect wide-spread low heat for "most used" frying operations.

"Click"... efficient Center Simmer... maintains boiling in any covered utensil.



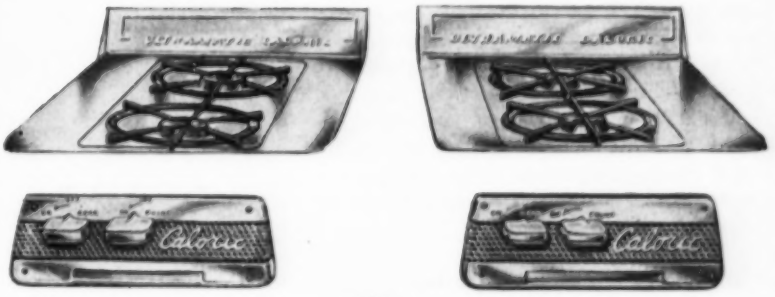
"Click"... gentle "Keep-Warm" heat... keeps foods perfect for serving without further cooking.



1

CALORIC BUILT-IN OVEN-BROILER UNIT

Brings added convenience to the modern gas kitchen. Smartly designed. Available in black enamel, white enamel, in pastel colors; in bright metal and satin finishes. Harmonizes with any decorating scheme. Can be installed in wood, metal, brick, or other materials. Eye-level controls eliminate stooping.



2

CALORIC BUILT-IN TOP-BURNER UNIT

Each unit includes 2 extra-capacity Speed-Set burners. Easily installed in island, peninsula or wall counters, wherever convenience dictates.

3

CALORIC DRYER

The original LO-HEET ..HI-BREEZE automatic gas dryer. Provides safer, faster and far more economical drying. Waist-high lint trap with exclusive Sifto-Bag®. One-knob control.

4

CALORIC WASHER

Fully automatic with vibration-free Gyro-Spin balanced action. Exclusive long-stroke agitator gives 25% more washing efficiency. Simple one-knob control.

CALORIC DISPOSER

Fully automatic gas disposer gets rid of garbage, trash, everything except metal or glass. With Calor-A-Tred foot pedal it's easy to load, even with both hands full. Calor-A-Set dehydration control with three settings for normal, wet, or dry refuse.

5

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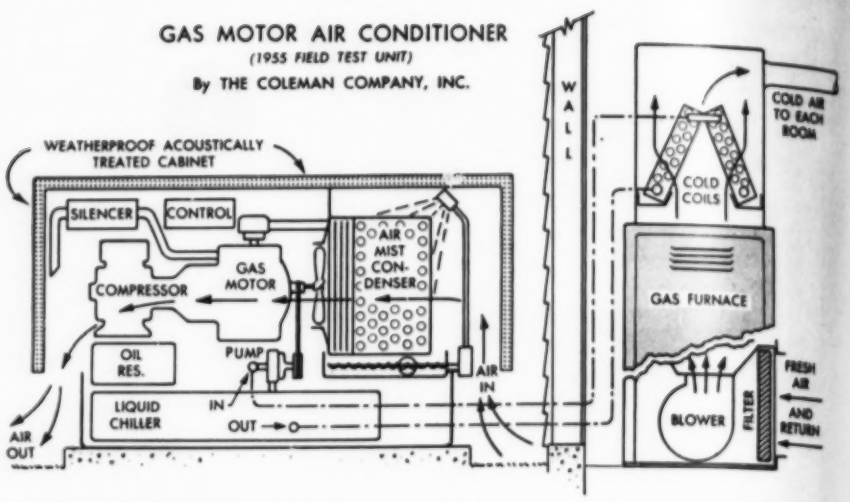
on and permits the housewife a much finer adjustment of the height of her gas flame. However, let us stay away from the numbered position valves. It looks like we are trying to copy our competition instead of leading it.

The third improvement is increased efficiency of the electric top cooking units. This is an improvement that has enabled the electric range industry to be more competitive on an operating cost basis. This increase in efficiency is accomplished by greater contact area between the pan and the heating coils. The efficiency of electric surface cooking units today is between 70 and 80%. This is a threat, because they are not only being competitive from an operating cost but they are putting less heat in the kitchen.

Controlled surface cooking

The fourth feature is thermostatically controlled surface cooking. This is a very worthwhile feature and merits the deepest consideration by gas-range manufacturers. It has great utility and is being so recognized by the housewife, as is being demonstrated by the thousands of new electric frying pans and utensils that have been and are now being sold. I am not going into the details of this feature as I am sure you have all seen this demonstrated by one of our controls companies for both the gas and electric range. Although this feature was first introduced by the competitive electric industry, we can do a better job with gas because of the quicker control of the heat into the kettle with a gas burner than with an electric sheathed element. I am sure that thermostatic control will be featured on quite a few of the 1956 gas ranges.

The fifth and last electric range feature is the quick pre-heat oven. The electric oven, by using the broiling element to help the bake element in the initial heating of the oven may do a faster pre-heating job than the gas range. We have not heard too much about this feature so far, but we must be prepared to meet it. We can, of course, simply increase our oven burner input and so decrease the oven heat-up time, but this leads us into difficulty at low oven heats which would be difficult to maintain with the presently used oven burners. So, perhaps, we should consider new oven burner designs that would allow quick heat-up and also low temperature oven use. Development here could lead to an improved burner, so that we could continue to do a better broiling job than the electric range.



Major components of gas-motor-driven air-conditioning unit are shown in schematic drawing. Refrigerant circuit is entirely self-contained. Chilled liquid lines leading from the remote unit to the cooling coil inside the house would be easy and inexpensive to install. The cooling coil shown is an inverted-V type installed in furnace plenum. Separate interior cooling unit with its own blower could be used.

Coleman testing air conditioner

IF THIS summer's program of field testing goes as well as expected, the Coleman Co. Inc., Wichita, Kan., expects next year to market limited production of a practical, economical gas-powered summer air conditioner for homes.

This model would be driven by a gas motor. Sharply increased production is scheduled for 1957 as Coleman puts gas-powered air conditioning on the mass market on a gradually expanding basis.

The company also expects that another—and totally different—system of residential gas air conditioning will be in the field test stage next year. This might be binary-type refrigerant jet, adsorption, or open absorption—three other gas cooling cycles on which Coleman is doing intensive research work.

Announcement of the company's research project was made by Sheldon Coleman, president and general manager, at the convention of the Southern Gas Association in New Orleans May 16. Immediately after speaking on "Progress in Gas Air Conditioning," Mr. Coleman released detailed information on the current gas motor-driven test model.

Mr. Coleman believes that air conditioning unit sales will be second only to the automobile market by 1963, he told members of the association. He predicted that a yearly rate of 1,250,000 sales of air conditioning units would be reached in less than 10 years.

The present test model gas-motor air conditioner—which is seen as the immediate forerunner of next year's production model—is a remote unit, for installation outside the house. A cooling coil would be installed inside, either in the furnace plenum or as a separate unit. With a plenum coil, the equipment would require no floor area aside from that already used by the furnace.

Another feature of the equipment is that it incorporates a sealed-in refrigerant circuit and a liquid chiller of "greatly advanced design." The usual plumbing skills would be sufficient to run the chilled liquid lines between the remote unit and the cooling coil.

Inside a weatherproof acoustic housing, which is no larger than the cooling tower required for an ordinary system, is a complete factory-assembled refrigeration system.

It includes all the elements of a typical refrigeration system and contains its own water-saving equipment, eliminating completely the need for the forced-air cooling tower with its pump, spray system, plumbing, and wiring.

The equipment to do this job includes the following items: Air-cooled gas motor, refrigeration compressor directly connected to the motor, evaporative condensing unit with pump and hydraulic slingers, liquid chiller, liquid circulating pump, 110-volt starter, muffler, oil reservoir, and controls. Current designs include 3- and 5-ton units.

Initial installed cost probably would be slightly higher than the cost of an electrical system of comparable capacity. However, when operating costs are considered, Mr. Coleman said, the advantage in most areas is so "spectacular that the gas motor system obviously becomes the best buy." With natural gas at 70 cents a thousand cubic feet, the gas motor system would have an operating cost (including gas, electricity, and water) of only half the cost of a typical electric system using 2-cent-per-kwh current.

GAS associations

A. B. Brown (right) is the newly elected president of the Indiana Gas Association. Other officers are (from left): V. C. Seiter, secretary-treasurer; E. G. Peabody, retiring president; and C. M. Cullison, vice president.

Indiana Gas Association elects Brown president

A. B. Brown, president of Southern Indiana Gas and Electric Co., was elected president of the Indiana Gas Association at its April 21-22 convention and C. M. Cullison, president of Central Indiana Gas Co., Muncie, was named vice president and thus placed in line to head IGA in 1956.

Brown succeeded E. G. Peabody, executive engineer of Citizens Gas and Coke Utility, Indianapolis, as president. V. C. Seiter, Citizens Gas Controller, was re-elected secretary-treasurer.

Attendance of approximately 350 was the largest in IGA history.

Feature of the two-day session was a panel discussion of underground gas storage with W. B. Tippy, vice president of Commonwealth Services Inc., New York, as moderator.

Ailing appliance market stressed at research meet

"The position of several gas appliances which have found broad acceptance in the American home have suffered serious setbacks. One basic appliance is nearly moribund and another seriously ailing."

Thus did H. R. Derrick, president of Alabama Gas Corp., set the tone for the AGA's 10th annual research and utilization conference in his keynote speech at the Cleveland meeting April 27-28.

Brow-wrinkling over the competitive position of the gas industry in the domestic market was evident from the start to the finish of the program. One panel, frankly labeled a "clinic," asked the question, "What About Our Competition and What Is the Way to Meet It?" And in the consideration of many other topics not strictly identified as competitive matters, the position of electricity and oil in the various domestic markets was alluded to with more than passing concern.

Domestic air conditioning was seen by Mr. Derrick as the last hope of holding the household load.

"With water and space heating in good health, domestic gas utilization would still be a substantial reality, load factors notwithstanding. However, should the use of our space-heating equipment (on which, incidentally, research has been most limited and promotion comparatively nil) assume a downward trend . . . the domestic gas business would be literally wiped out."

Mr. Derrick reiterated the past warnings of such prominent heating authorities as Sheldon Coleman that the electric utility industry is being forced to go into the househeating business to balance its summer cooling load.

"A qualified representative of the top manufacturer of electric heat pumps estimates that the total number of heat pumps of all makes sold in 1954 was 3500, that this year the figure will leap to about 9000, and in another 10 years the annual sales of electric heat pumps will be about 250,000.

"While initial cost of this equipment is still high, they claim to be making substantial progress in reducing it, and hope to bring it down to where it will represent 10% of the cost of the house, including ducts, as compared to the present 15% for homes in the $15,000-$20,000 bracket. Moreover, they anticipate that by 1960 the heat pump will be competitive in 85% of the residential market interested in all-year air conditioning.

"I cannot help feeling that if gas-fired air conditioning equipment, reasonable in first cost and relatively troublefree, had been available only five years ago . . . the electric utilities would not have looked upon electric heating as fondly as they do now."

H. F. Carr of Baltimore Gas & Electric Co., added some fuel to the argument in a talk on "The Impact of Oil and Electric Resistance Househeating on the Gas Househeating Load." His report on the widening acceptance of electric heating in small, modest dwellings was particularly disturbing. (Ex-

F. A. Ryder, South Wind division, Stewart-Warner Corp., and Otto B. Vogel, Boston Consolidated Gas Co., look over the research publications on display at the research and utilization conference.

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cerpts appear elsewhere in this issue.)

In a discussion of "New Operating Features of Domestic Electric Ranges," Walter F. Hagman, research and development director of Globe American Corp., declared, "We must continue to improve the gas range technically, by improving upon every feature inherent in it, by somehow matching and improving upon every inherently good feature of the electric range, and by eventually eliminating whatever we cannot improve."

Mr. Hagman's thesis was that, while important electric range innovations are merely matching inherent characterestics of gas ranges (e.g., infinite number of heats) it is vital that redoubled research efforts be directed to keeping the gas range well ahead of the competition. (Excerpts from Mr. Hagman's talk appear elsewhere in this issue.)

A sharp warning that the gas utilities must continue to hold the lead in water heater performance was sounded by Kenneth Wood of East Ohio Gas Co., Cleveland. However, his talk, "Higher Speed Electric Water Heating at Higher Cost," provided some reassurance for the present as regards the new developments in competitive water heaters. (See page 50.)

Only certain features of the experimental ranges designed by the AGA Laboratories and demonstrated last year have been incorporated in production ranges, according to George M. Nash of Central Hudson Gas & Electric Corp., in his talk on "Progress in Improving Domestic Gas Ranges." Ranges with features based on the other ideas built into the experimental models will only be available "when the utilities express their desire to promote and sell them and to support those manufacturers who offer these new tools," he declared.

The fact that improvements developed in research do not always find their way to the sales floor was brought out by N. B. Bertolette, who cited the industry's experience with the deep fat fryer which the AGA laboratories built in 1952. "Recently I was quite surprised to learn that only two manufacturers incorporated these design recommendations into their fryers," said the president of the Hartford (Conn.) Gas Co.

Group discussions feature industrial gas session

Some 250 delegates gathered in Boston recently for the 1955 AGA sales conference on industrial and commercial gas. The conference, which resembled a New England town meeting, featured group discussions on gas fryers,

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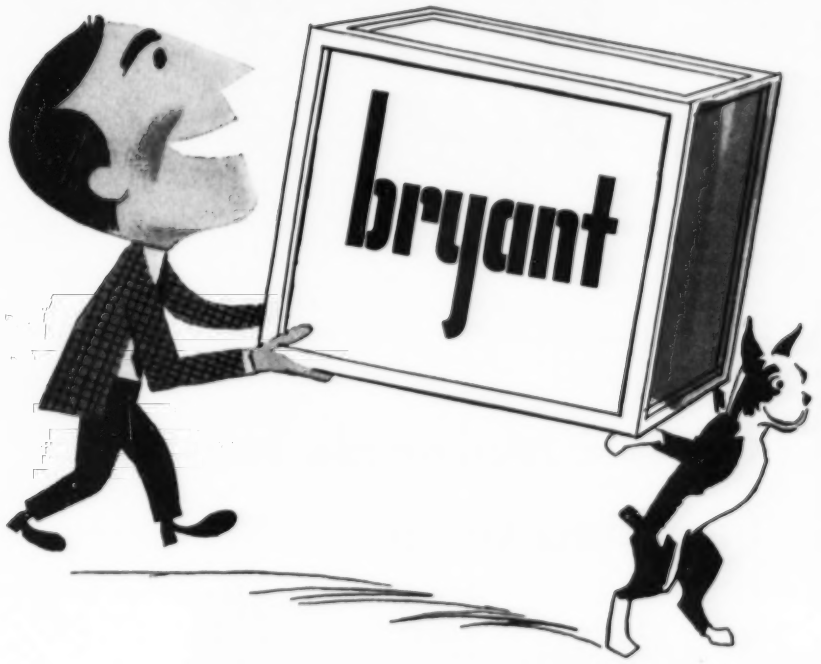

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For bigger profits now, for a secure and prosperous future—see your Bryant Distributor. Ask him about Bryant's big "Mr. B" action program, and how it can make sales and money for you!

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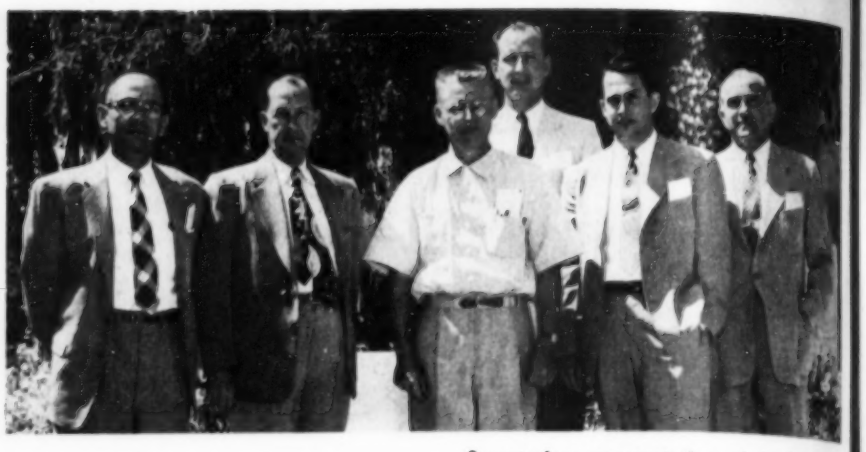
bake ovens, commercial incineration, water heating, air conditioning, industrial furnaces, dual fuel equipment, low and high temperature equipment, direct-fired equipment, heating tools.

In addition there were talks on advertising, selection and training of industrial and commercial manpower, and fire and explosion hazards.

Covering industrial and commercial advertising, W. S. Redpath, of Ketchum, MacLeod & Grove Inc., said "the historical levels of spending by gas companies to advertise industrial and commercial gas have been so low that some say there is nowhere to go but up. Gas companies appear to advertise to the over-all tune of not much more than one-twentieth of 1% of annual revenue. Gas equipment manufacturers spend approximately one-half of 1% of their yearly gross sales. Residential budgets are about 16 times the industrial and commercial percentage."

During the conference, awards in the GAMA PEP campaign were presented. Winner among companies having more than 100,000 meters was the Washington (D. C.) Gas Light Co.; from 25,000 to 100,000 meters, the Piedmont Natural Gas Co. Inc.; and among those companies with less than 25,000 meters, Chattanooga Gas Co.

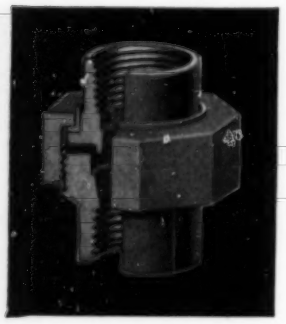


Seventy-four representatives of the PCGA attended the recent distributors' conference held at Camelback Inn near Phoenix. Among those in attendance were (from left) Frank Bater, San Diego Gas & Electric; Henry Sargent, Earl Jorgensen, and Walter Lucking, Arizona Public Service; Ashton O'Donnell, Stanford Research Laboratory; and J. E. Kerr, PCGA.

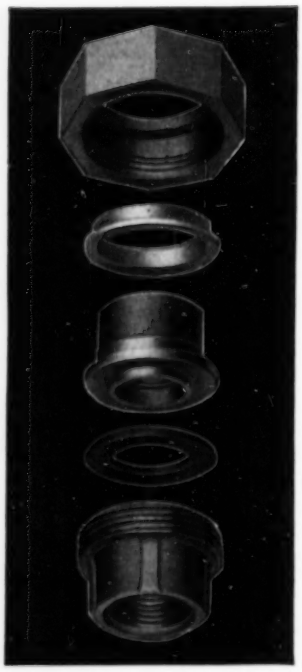
C. S. Stackpole appointed managing director of AGA

Chester S. Stackpole, general sales manager of the heating and cooling division, Union Asbestos & Rubber Co., Chicago, has been appointed managing director of the American Gas Association. He joined the association this month, succeeding H. Carl Wolf, who resigned earlier this year because of illness.

C. S. STACKPOLE
Managing Director



New CRANE Malleable Iron Insulated Union



Gives cathodic protection at meters—Galvanic corrosion in service piping can be effectively reduced by cathodic protection at meter connections. This rugged, malleable iron Crane union breaks the current path by means of special insulation.

Between union ring and tail-piece there's an L-shaped washer of laminated phenolic thermosetting plastic. Between tail-piece and thread-piece a thick black rubber gasket breaks the metal-to-metal contact. Both insulating parts have high dielectric strength.

New union measures just slightly longer than the regular ¾-inch Crane malleable union—approximately 2-7/32 inches, end to end. Packaged in cartons of 30.

Check your Crane Representative on these items!

New ¾-inch Safety Vent Elbows

A flexible stainless steel coil spring takes the place of the old bar grille or rigid screen in this new Crane vent elbow. Keeps out bugs, insects, foreign matter. Flexes outward if regulator is vented. Durable, dependable—die cast of zinc alloy.

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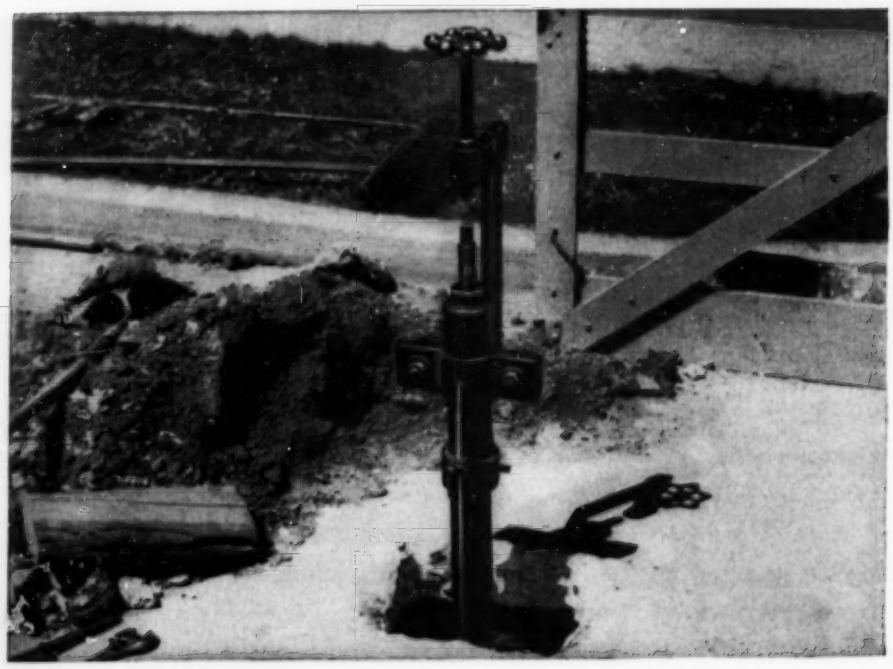

Modern leak control

with CARBOSEAL *Anti-Leak*

Trade-Mark

The gas company that is using this modern main-tapping device (it works through street openings only 1 foot square) has chosen the *modern* method of stopping leakage due to dried-out fiber packing—CARBOSEAL Anti-Leak.

This progressive gas company knows that CARBOSEAL Anti-Leak is:

• effective • inexpensive • lasting • easy and economical to apply

Get all the facts. Write for the booklet, Form 4506—or the 16 mm. color-sound movie, "CARBOSEAL Anti-Leak Stops Gas-Main Leakage," which will be sent to you without charge.

CARBOSEAL ANTI-LEAK

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associations • *Continued*

Before becoming associated with Union Asbestos & Rubber Company, where he helped in establishing a new division, Mr. Stackpole served as vice president in charge of domestic sales, advertising, sales promotion and service activities of the Williams division of the Eureka Williams Corp.

For more than 20 years, Mr. Stackpole served as assistant manager, and then manager of merchandising, sales promotion, and domestic gas and electricity sales of Consolidated Gas Electric Light & Power Co. of Baltimore, now the Baltimore Gas and Electric Co.

After graduation from Brown University, he joined Stone and Webster Inc., and from 1922 to 1928 was engaged in sales, sales management and promotion activities in companies owned or managed by that holding company in New England and Virginia.

During his 26 years of service in the utility industry, he has been very active in AGA affairs. He has served on and headed many association committees, including chairmanship of the house heating committee, and as vice president while serving as chairman of the residential gas section.

Electronics equipment stressed by accountants

Electronic equipment came in for a large share of discussion at the recently held National Conference of Electric & Gas Utility Accountants, when more than 1300 delegates attended the AGA-EEI sponsored session in Chicago.

Dr. Howard Aiken, director of Harvard University's computation laboratory, speaking on electronic data processing at the first general session, pointed out that men of business should demand machines designed specifically for their purposes instead of attempting to use equipment intended for something entirely different. He warned that electronic computers should not be accepted uncritically as a panacea for all data processing problems.

A. Paul Thompson, Iowa Power & Light Co., noted the increasing mechanization of offices and said electronic devices are not competing with us nor are they making the role of an accountant easier. Rather they are serving us and placing a higher premium on accounting skill.

J. W. Balet, Consolidated Edison Co. of New York, said that in working out programming for a computer to be delivered to his company in April 1956, the entire electronics staff was recruited from within the controller organization of the company. The computer may be a direct substitute for present punch card equipment, he said, but it will be

One of America's Greatest Industries Operates Underground!

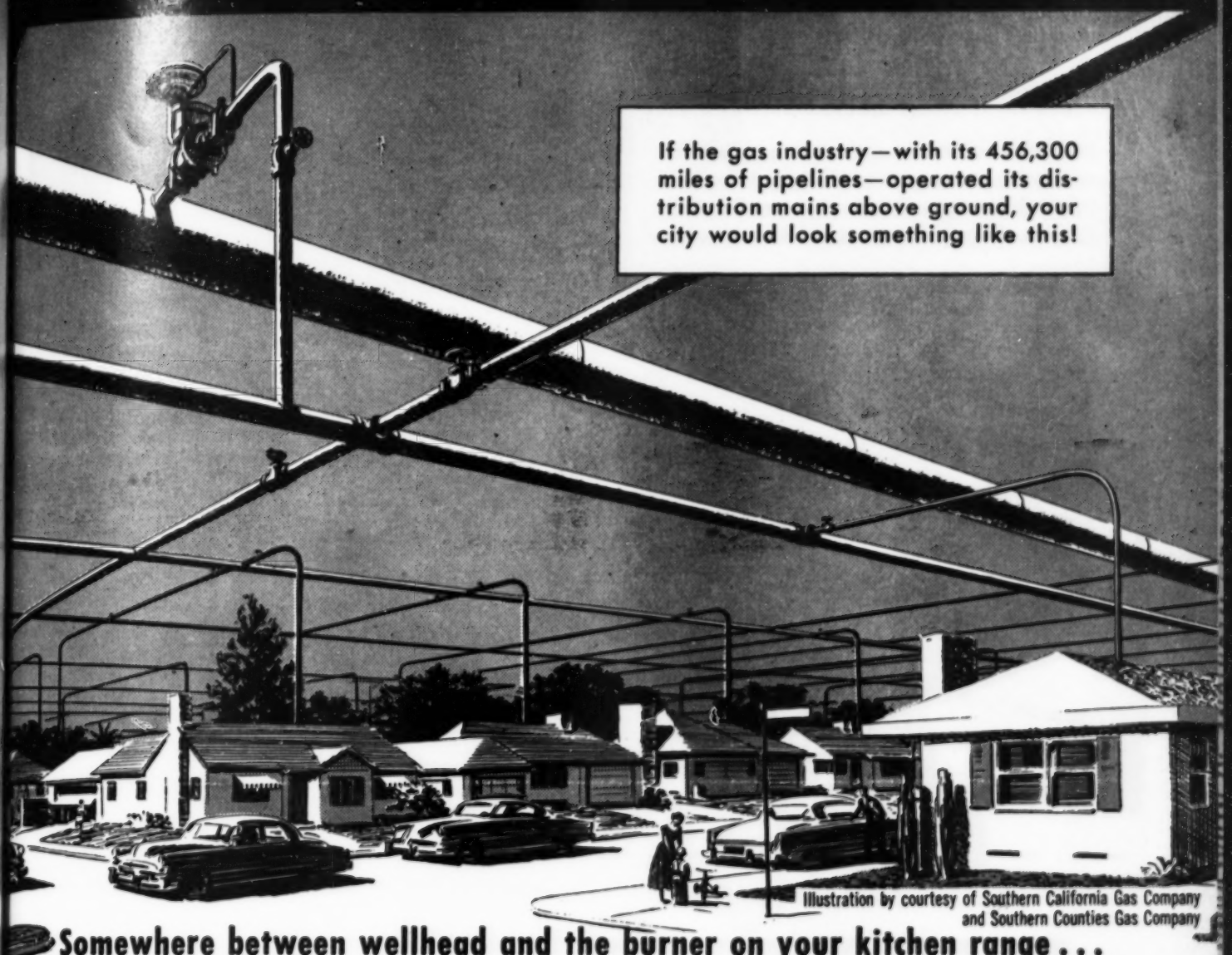
If the gas industry—with its 456,300 miles of pipelines—operated its distribution mains above ground, your city would look something like this!

Illustration by courtesy of Southern California Gas Company and Southern Counties Gas Company

Somewhere between wellhead and the burner on your kitchen range . . . THERE'S A PLACE FOR YOUR PRODUCT IN THE GAS INDUSTRY!

Natural gas at wellhead is under a pressure of 2,000 psi (pounds per square inch). Perhaps a thousand miles away, it flows from the burner of your kitchen range at 4 ounces per square inch . . . a pure blue flame representing clean utility.

To bring about this reduction in pressure, and to deliver clean, usable gas into 28 million American homes, factories, and businesses, the gas industry uses almost every product and piece of equipment known to man!

Somewhere along this journey of gas from producer to consumer, there's a place for your product . . . for technological developments and the continued expansion in the gas industry are constantly creating new and additional markets for manufacturers.

The gas industry is big and growing bigger. It's America's sixth largest industry, with assets of 14 billion dollars and pipelines spanning more miles underground than America's great network of railroads spans aboveground.

79% of the money . . . to be spent for new pipelines this year will be spent for *gas* pipelines.

Expenditures for gas transmission lines to be started this year total over a billion dollars. And every dollar spent for transmission, means additional dollars spent for distribution and utilization.

To sell this huge market, you need the COMPLETE coverage given only by GAS—the leading gas industry publication. *Last year, 131 companies used GAS exclusively in their advertising to the gas industry.*

Write for your free copy of "Natural Gas Pipeline Projects"—a list of gas transmission projects to be started in 1955, representing a total expenditure of over a billion dollars.

- More circulation . . .
- More editorial pages per issue . . .
- More advertising pages per issue
- Lower advertising cost per thousand circulation . . . than any other gas industry publication.

NBP A Jenkins Publication • 198 S. Alvarado St • Los Angeles 57

necessary to maintain a sizable clerical force to maintain control over the payroll.

Measurement short course attracts almost 900

Close to 900 persons attended the 30th annual Southwestern Gas Measurement short course held in April on the campus of the University of Oklahoma.

Following the semi-formal general session that opened the school, those

Members of the general committee of the gas measurement short course are (seated, from left): K. R. Tibbets, Warren Petroleum; W. H. Carson, University of Oklahoma; Miss Kate A. Niblack, Oklahoma Utilities Association. Standing: R. B. Fleske, Cities Service Gas; R. F. Nowlin, United Gas Corp.; M. D. Gilbert, Rockwell Manufacturing; Roland O. Cox, Lone Star; R. R. McCafferty, Pioneer Natural Gas.

enrolled spent the remainder of their time in classroom sessions. There were seven classes covering a great variety of subjects as they are related to gas measurement and regulation taught concurrently during each hourly period. Each teacher had been selected as a person well qualified to cover the subject assigned to him, but during discussion periods, the teachers found it necessary to rely on attendants to answer some of the questions posed.

According to report, the educational exhibits were exceptionally good, with cutaway models showing the interworkings of the most intricate instruments.

Roland O. Cox, who is incoming chairman of the general committee of the short course, announced that the 1956 course will be held at the University of Oklahoma, April 17-19.

Sales personnel get food for thought at conference

Facts, figures, questions, straight answers, and plenty of mental food to digest were on the schedule for the more than 250 gas industry sales personnel attending the eastern natural gas regional sales conference held in Pittsburgh recently.

T. H. Evans, Equitable Gas Co., chairmanned the two-day session and led off with an optimistic keynote address that stressed the vigor and bright future of the gas industry. However, he said, "there is one essential ingredient necessary for the growth and well-being of the gas industry—people who can sell."

Taking a look at the future, Coleman Co.'s Clifford E. Hall told the delegates that the gas industry needs something

...Specially prepared for engineers interested in Gas Odorization... a 12 page, colorfully illustrated bulletin, with full details on INSTALLATION, OPERATION and MAINTENANCE of Peerless Odorizers — the most widely used odorizers throughout the Gas Industry.

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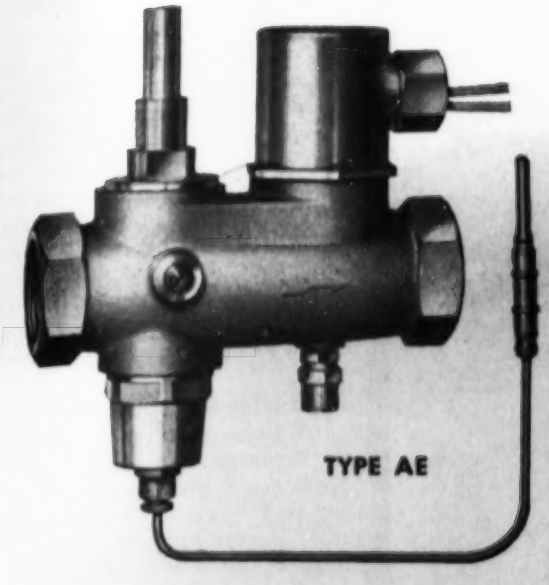
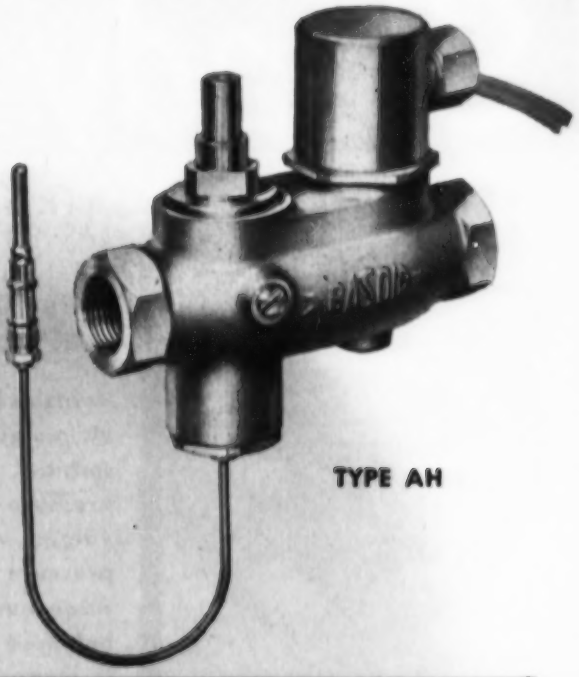
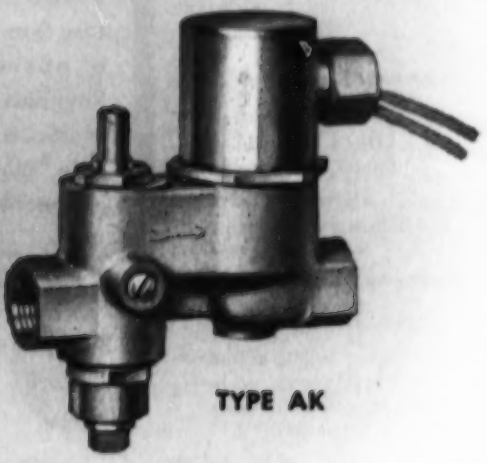


TYPE AE



TYPE AH

A FULL RANGE OF BASOID VALVES



TYPE AK

Since we last talked Basoid valves with you, two sizes have been added—1″ and ⅜″ pipe sizes—to give a full selection range for your appliances that require automatic main gas control plus an automatic pilot with complete gas shut-off.

The same features of solenoid valve and automatic pilot in one casting are common to all Basoid valves. Construction materials and basic design are the same in all sizes. Stainless steel plungers, aluminum shading rings, aluminum bodies, and other corrosion-resistant materials enable these valves to laugh at all gases, even those with high sulphur content.

Each size can be supplied with two pilot tappings, with one tapping, or with none, as you see fit. You can have a pressure tapping below the solenoid or a manual control screw in the same place.

Voltages: 20 v., a.c.; 113 v., a.c.; 230 v., a.c.; and 440 v., a.c.

HOW'S THIS FOR A LINE UP?

Type	Size	Capacity Btu/hr. @ 1″ Pressure Drop		
		Mfd. Gas	Nat. Gas	LP Gas
AE4511	1″	283,000	419,000	889,000
AE4411	¾″	230,000	340,500	723,000
AH4411	¾″	145,000	214,600	455,000
AK4311	½″	107,000	158,360	336,000
AK4211	⅜″	87,000	170,000	273,200

Write us for the Complete Specifications

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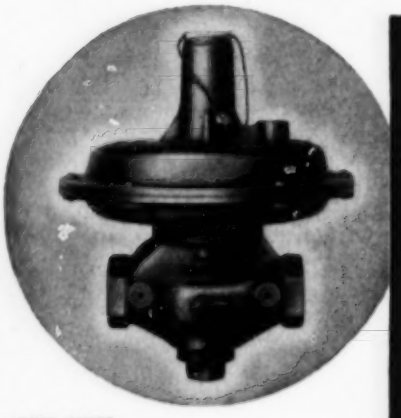
Dept. SC-6

MILWAUKEE 1, WISCONSIN

Steady

REYNOLDS LOW PRESSURE REGULATORS



PIPE SIZES:
¼" to 8"
¼" to 3" with screw connections
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Reynolds Low Pressure Regulators guarantee steady, constant, unvarying outlet pressure even though the volume varies and inlet pressure fluctuates. Precision built and delicately balanced for accurate performance on low pressure installations, the units illustrated are backed by factory tests over a wide range of operating conditions. Reynolds Low Pressure Regulators are economical and safe. Our Engineering Department is at your service.

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Strong — Corrosion Resistant — Light Weight — Sizes 2" thru 12"

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Subsidiary of
Cadillac Malleable Iron Co.
Cadillac, Michigan

to pick up the summer gas load, and that gas-fired air conditioners could provide part of the answer. For that reason, he said, his company is spending more than half a million dollars this year for research to perfect a summer air conditioner that will be competitive in original cost, in operating cost, and in maintenance. He said that the end result is in sight, but that at least six or seven additional manufacturers will be needed to stimulate sales to the consumer.

In a sobering and thought-provoking talk, J. A. Cerny, director of marketing for the Bryant division, said "a healthy gas appliance industry is essential to a healthy gas industry, but business is not healthy." According to Mr. Cerny, the gas heating load is being threatened by sub-standard installations, competition, and complacency. In addition, he pointed out, there is a tendency to reduce prices at the expense of quality.

G. M. Rohde, a distributor of Ruud water heaters, spoke on the necessity of adequately sizing gas water heaters as a sales tool. He foresaw a water heater with a 50-gph recovery rate and a 100° rise. With this type of water heater, he said, the entire family will be able to use hot water for their many activities simultaneously without waiting for water to heat after the supply has been exhausted.

Henry A. Wade receives Hanlon award for service

The Hanlon Award, highest honor in the natural gasoline industry and one of the ranking awards in the petroleum industry, was conferred on Henry N. Wade, process consultant, Stearns-Roger Manufacturing Co., Denver, at the 34th annual convention of the Natural Gasoline Association of America.

Henry Wade is the 19th recipient of the Hanlon Award which is conferred each year by the NGAA for outstanding service to the natural gasoline industry. Donor of the Award is E. I. Hanlon, chairman of the board, National Bank of Tulsa, and a pioneer in the natural gasoline business.

The presentation was made by former NGAA president, J. H. Dunn, president, The Shamrock Oil and Gas Corporation, Amarillo. The citation read in part: "With this award . . . we are officially recognizing the major role played by this man in the technical advances of our industry. We are honoring an engineer who pioneered with original thinking and ideas in the design of natural gas processing plants. His ideas and the resulting plants have

SR-100 Combination Pressure Regulator and Thermo-Electric Safety Pilot. ⅜" and ½". Capacities up to 90280 B.T.U.

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GAS CONTROLS

T-11 and T-15 Appliance Regulators. ½" and ¾". Capacities up to 284,000 B.T.U.

SR-200 Combination Pressure Regulator and Thermo-Electric Safety Pilot. ½" and ¾". Capacities up to 226,200 B.T.U.

— *finest controls on the market today*

There's no substitute for dependability in a gas control for the proper operation of today's modern automatic appliances. Manufacturers for whom Thermac controls are engineered and built find the following design principles planned into each Thermac product:

1. Higher B.T.U. capacity, per size.
2. More compact. Easy and less expensive to install.
3. Fewer parts readily accessible without breaking line connections.
4. Dependable in performance and rugged to withstand years of hard service.
5. Finest materials and workmanship. Resistant to corrosion. Trouble free.

Examine any Thermac product thoroughly. Test it. Compare its performance, ease of adaptability, price and quality. Send for recommendations and samples. See how readily Thermac controls fit into your program.

Call Thermac first for immediate delivery.

Model TROD Pilot Regulator.

Aluminum Alloy Manual Main Gas Shut-off Valve. Free flow. ⅜", ½", ¾" and 1".

TR-34D-155, T-50, T-60 and T-70 Regulators. ¾" to 2½". Capacities up to 2,160,000 B.T.U.

Assembly of Thermac Gas Shut-off Valve and Appliance Regulator.

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HM COMPANY

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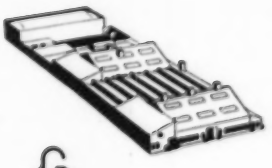

"24 years experience building gas controls."

Certified by A.G.A.

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Please send, without obligation to me, the HYDRAUGER BOOKLET which shows relative costs and speeds of BORING as well as specifications of various Hydrauger models.

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2" to 24" BORES - Up to 250' long.

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AVOIDS EXCESSIVE TRENCHING

Hydrauger bored holes for pipe installation invariably reduce costs 80% to 90% by eliminating trenching and back-filling to say nothing of man-hour labor savings and safety to highway traffic.

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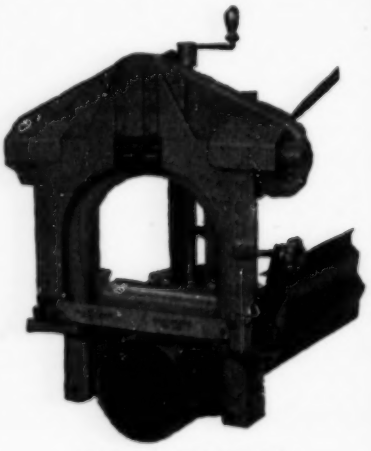

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given the industry an increased yield of products by more economical means while at the same time improving the ultimate recovery of products from the reservoirs where they originate."

HENRY WADE
Award winner

Following his graduation as a mechanical engineer from Cornell University in 1914, Mr. Wade was engaged in electrical engineering work with the Cutler-Hammer Manufacturing Company, Milwaukee. In 1932 he formed his own engineering firm, Parkhill-Wade Inc., at Long Beach. As president and chief engineer of the firm, he designed a number of natural gasoline plants for West Coast producers and in 1932 built the first large-scale gas dehydration plant in the country for the Montana Power & Light Company. This was the forerunner of many similar plants. He is most widely known for his designing and building, in 1939, the first high-pressure gas cycling plant for processing the two-phase gas streams from deep distillate wells along the Gulf Coast.

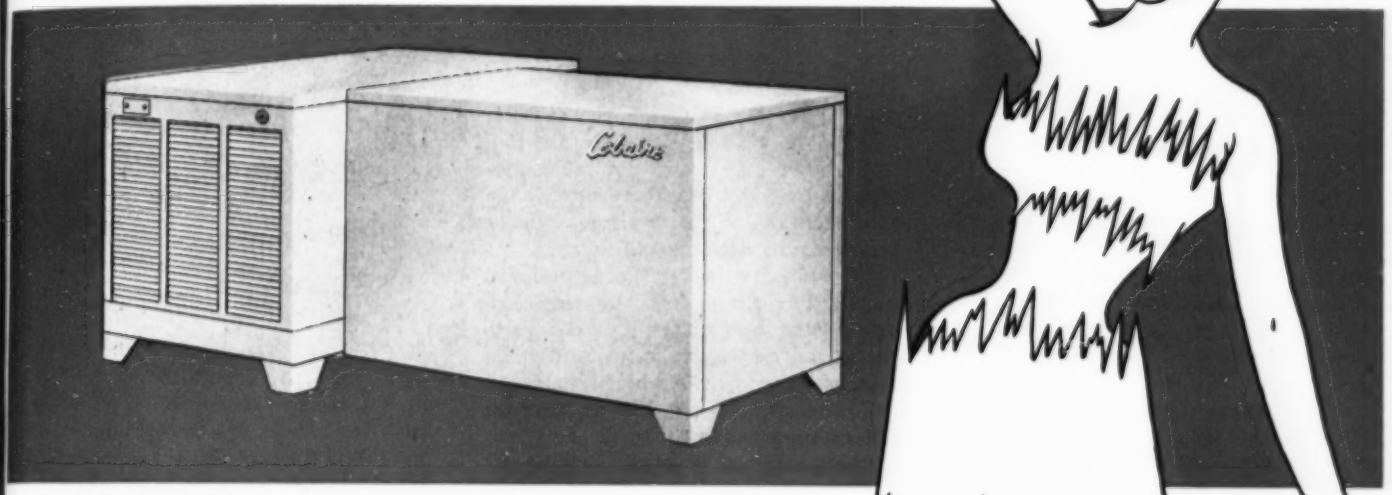
GAS association notes

More than 240 members and guests of the American Society of Heating & Air-Conditioning Engineers attending a regional meeting in Oklahoma City recently heard reports by ASHAE President John E. Haines and Director of Research Elmer R. Kaiser. Also presented were papers on residential cooling, removal of moisture, pressure losses of divided-flow fittings, and a new method of calculating air conditioning loads.

Grove Lawrence, vice president, Southern California Gas Co., Los Angeles, has been selected to serve as second vice chairman of the operating section of the AGA for the remainder of the association year. He succeeds Frederic A. Hough, Bechtel Corp., San Francisco, who resigned in December because of a change in company affiliation.

we're COOLING with GAS

At last, nature's magic fuel has been harnessed to produce a new standard of effective cooling. After years of research and development, Cobell Industries points with pride to new Cobaire, a practical natural or LP gas powered air conditioning system that *cuts operating costs in half!*

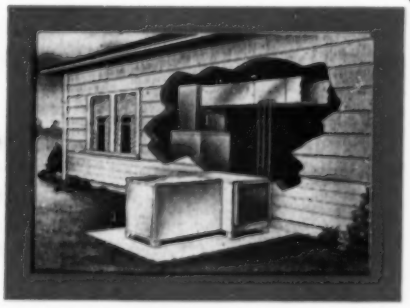


Revolutionary Cobaire is tomorrow's air conditioning . . . TODAY!

- Cuts Operating Costs 50%*
- Delivers Full-Rated Capacity
- Eliminates Cooling Towers
- Requires No Special Wiring or Pipe

COBAIRE INSTALLS EASILY, SENSIBLY

Cobaire is mounted on a concrete slab adjacent to house or building. Outdoor installation eliminates all inside noise. Perfect for old homes or new. Available in 3 to 10 ton sizes for every need.



Get full details on new, different Cobaire. Write or wire for literature.

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*Compared with similar electrically powered unit

GAS

new products

To secure further information on products or new literature, simply fill out the coupon and mail, indicating by number the information or literature needed.

1 Commercial Dryer

A commercial gas clothes dryer, custom designed for motels, hotels, and apartment buildings, has been announced by Caloric Appliance Corp. An accumulator coin meter with a vault-type money box that cannot be pried open is a special feature of the Caloric 125X dryer.

The dryer utilizes the Caloric Lo-Heet Hi-Breeze drying principle, in which a high-capacity blower sends a strong current of purified warm air into a perforated cylinder where clothes are gently tumbling.

Load capacity is approximately 18 lb of wet clothes. Drying time varies with the weight, size and wetness of the load and type of fabric.

Caloric Appliance Corp.

2 Data Reduction System

A new packaged data reduction system for converting pneumatic or electric signals into tabulated digital records, the Fischer & Porter automatic logger may be integrated with industrial instrumentation systems currently in use, for automatic control, computing, cost accounting, statistical analysis, or process reset with a punch card programmer.

Developed especially for economical transition from manual or semi-automatic operation to completely automatic process control, the Automatic Logger is compatible with present control instrumentation, and is versatile for future reapplication.

Measurements of pressure, temperature, flow, weight, stress, level or other variables of concern to operating, engineering, and accounting personnel are automatically recorded in individual vertical columns on the log sheet, so that any variable may be readily scanned for trends. A punched tape with identification digits for each variable is punched simultaneously with the typed log, providing data in a convenient form for further computations.

Readout may occur at hourly, half-hourly, or other preset intervals.

Fischer & Porter Co.

■

3 Clamshell Bucket

A new ⅜-yd clamshell bucket, which uses two hydraulically operated rams instead of a single center ram to handle bowl action, has been developed by Bucyrus-Erie Co. for use with its truck-mounted, all-hydraulic H-3 Hydrocrane. The new bucket has been designed to step up the Hydrocrane's digging output.

Bucket deck area and internal size have been increased. Struck measure capacity is 10.4 cu ft.

The bowl sections are curved to provide maximum penetration and quick loading with minimum heeling. In addition, bowl pivot shafts have been replaced with short pins so there is nothing to obstruct loads in the bucket. Holes are provided in the bowls for side cutter teeth.

Bucyrus-Erie Co.

■

4 Compressor/Vacuum Pumps

A new line of two-stage 100-lb rotary air compressor/vacuum pumps for shop air systems, drill rigs, pneumatic conveyors, gas compression, and similar applications has been announced by Allis-Chalmers Manufacturing Co.

Mail this Coupon for **NEW PRODUCTS INFORMATION** / **COPIES OF NEW LITERATURE**

GAS, 198 S. Alvarado St., Los Angeles 57, Calif.

6/55 Fill in numbers of items in which you are interested.

No. ..... No. ..... No. ..... No. .....

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NAME AND TITLE.....

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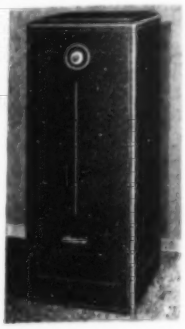
The new compressor/vacuum pump is water cooled and consists of a separate low pressure unit coupled to a high pressure unit, both mounted on a common bed plate. It is designed for direct connection to motors, although it may be driven through speed decreasing or increasing gears by motors, engines or turbines.

While of nominal 100-lb capacity, the new equipment is available in eight sizes to handle from approximately 250 cfm to 1800 cfm and for pressures ranging from 60 to 125 lb.

Allis-Chalmers Manufacturing Co.

■

5 Large-Area Heater



A new Big Boy vented gas heater for large-area heating is the latest offering of Perfection Stove Co. Known as Model X990, the 100,000-Btu furnace-type counterflow space heater produces plenty of heat for stores, school rooms, service stations, warehouses, and garages. It will also heat several rooms of a dwelling.

The quiet, powerful, furnace-size blower draws cool air in at the top, spreads a smooth carpet of warmth at the bottom.

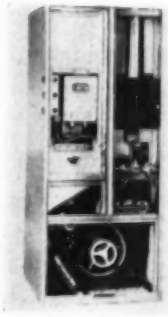
There are only three connections—flue, gas supply and 110-volt line. It is completely automatic in operation. The quiet, dependable burner is of the single-port type, precision-made of sturdy cast-iron and carrying a lifetime guarantee.

Perfection has finished this heater in silvertone brown baked enamel, bonded to rustproofed steel.

Perfection Stove Co.

■

6 Heater-Cooler



A new, compact combination heating and air conditioning unit is available from Utility Appliance Corp. Available in 2-ton and 75,000-Btu and 3-ton and 105,000-Btu sizes, the new combination units feature quietness of operation through use of the Utility blower with its resilient mounts. Another Utility feature, the resiliently mounted full-floating refrigeration chassis, increases the quiet operation.

The refrigeration chassis makes the unit suitable for project work where all homes are not air-conditioned at time of construction. The unit is designed to be sold as a furnace section and cabinet only or as a complete summer-winter air conditioner.

Utility Appliance Corp.

■

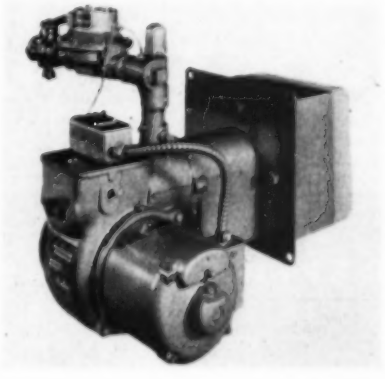
7 Luxury Range

An all-chrome top is featured on Florence Stove Co.'s new luxury styled range. The 36-in. model has five burners and the fifth, or center burner, has an optional feature of a cast aluminum griddle.

The large 16- by 18- by 14-in. oven has a glass window consisting of two panes of glass, the inner pane being removable for washing. Other features are the swing-away broiler located underneath the oven and the Florence lock-stop gas cocks for surface burners.

Florence Stove Co.

■



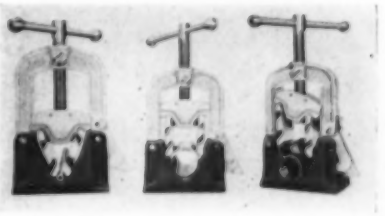
8 Packaged Burner

A small packaged burner developed by Eclipse Fuel Engineering is reported to provide an effective method for complete incineration of waste materials. Designed to produce a slow, steady burn, with a semi-luminous flame, the burner has a range from 50,000 to 500,000 Btu per hour.

The burner is ready to operate as soon as the gas supply is piped to burner and the electric motor control switch is connected.

Eclipse Fuel Engineering Co.

■



9 Pipe Vise

Jaws that grip with "rocking wedge" action provide a number of important advantages in the new Toledo No. 1 pipe vise, announced by the Toledo Pipe Threading Machine Co.

These benefits for the user include: (1) firm gripping action without crushing; (2) greater versatility with ability to grip securely either very small or large pipe (⅛-in. to 2½-in.), as well as irregular shapes such as valves, tees, ells; (3) jaw action that tends to eliminate marking of pipe.

The vise has heat treated jaws, and is ruggedly constructed for heavy duty use.

Toledo Pipe Threading Machine Co.

■

10 Truck-Powered Tools

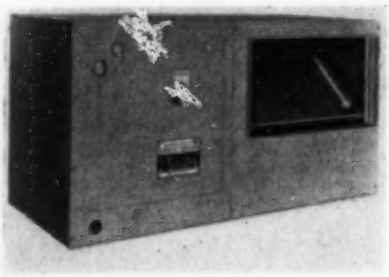
To increase the usefulness of pick-up trucks, H. S. Watson Co. has developed a new rear power source and a new line of truck-powered tools.

Available in kit form, the new compact rear power source equipment is adaptable to most light- and medium-duty trucks. The rear power source terminates in a standard spline, which permits driving a wide variety of equipment.

Also available with the rear-power source is a new lightweight post hole digger, which has been designed for simplified one-man digging. The digger can be angle-operated any place within a 4- by 8-ft area without moving the truck.

H. S. Watson Co.

new products • *Cont'd.*



11 Cooling Unit

A new, space-saving horizontal cooling unit for residential air conditioning has been introduced by the Sunbeam Air Conditioner Division of American Radiator & Standard Sanitary Corp.

This self-contained model, with hermetically sealed refrigerant circuit, water-cooled, is made without blower for use in conjunction with new or existing forced air heating systems. Model HCA-2H or -3H is designed for easy installation with any modern blower-equipped furnace and may be had in either 2-hp or 3-hp capacity. It can be mounted overhead, placed on ceiling joists in the attic or suspended under the floor in crawl space.

Sunbeam Air Conditioner Div.

12 Gas Range

Outstanding feature of Dixie Products new Dixiemaster 11F-7GL is the full-size gas range with a new 224-sq in. cast aluminum griddle for added food preparation convenience in addition to the four conventional burners. Covered with an acid resistant white porcelain enamel lid when not in use, the griddle itself may be easily removed for cleaning. It can be quickly replaced by a large center grate to provide additional top burner accommodation for large cooking vessels.

Dixie Products Inc.

GAS trade literature

13 Boiler Brochure

A four-page brochure (AD-137) describes new self-contained boilers of Cleaver-Brooks Co. Suggested boiler room layout and dimensions are included with specifications on LR and CB models.

Cleaver-Brooks Co.

■

14 Water Heater Booklet

John Wood Co. has released a 16-page illustrated book, "How Do You Choose a Water Heater?" that provides non-technical information to enable a customer to decide upon the water heater of his choice.

John Wood Co.

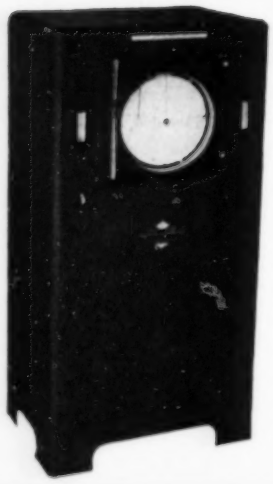
■

15 Boiler Guide

A 20-page bulletin from Babcock & Wilcox has been released to provide operators of stationary and marine boilers with an authoritative guide for selecting the most efficient and economical refractories for their boilers.

Babcock & Wilcox.

AC-ME RECORDING GRAVITOMETER • AC-ME SPECIFIC GRAVITY BALANCE



for accurate gas measurement.

- SENSITIVE
- CONTINUOUS RECORD
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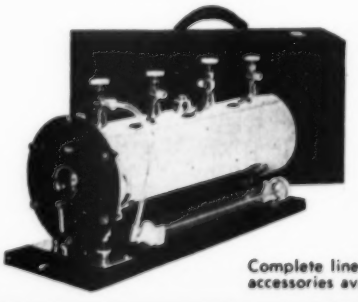
This instrument has been designed for accuracy in determining specific gravity of gas—it contains no rotating parts that will wear out and operates on the principle of weighing a volume of gas in comparison with an equal volume of air.

ADOPTED BY THE NATURAL GASOLINE ASSOCIATION AS THE MEANS FOR DETERMINING THE SPECIFIC GRAVITY OF NATURAL GAS

Designed and constructed to meet the specifications required for determining the specific gravity of gas under the various conditions found in both field and laboratory.



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NO BASEMENT NEEDED!

There's **NO DOUBT** *about it!*

Automatic – Low Cost

MOST EFFICIENT *Gas* **BURNER** · **MINIMUM FIELD SERVICE** · **DEALERS ACCEPTANCE** · **USER SATISFACTION** · **SILENT IN OPERATION**

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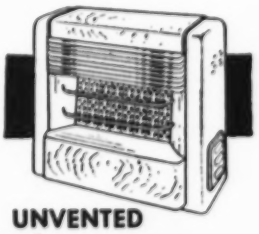
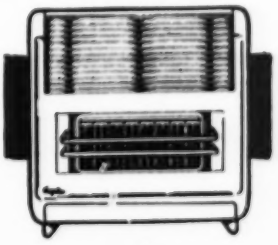
GAS FLOOR FURNACES

The most essential item in your home for the comfort and protection of your family is the heating plant! The cost of installing a New Empire Gas Floor Furnace is surprisingly little . . . the warmth and convenience you'll enjoy must be experienced to be believed!

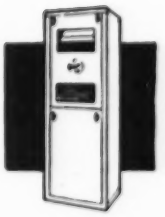
If you plan to build a new home or improve your heating plant, your Authorized Empire Dealer has experienced engineers to help you without charge.



UNVENTED *Gas* HEATER



Gas CIRCULATOR HEATER



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COUNTER FLOW AIR CONDITIONER

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EMPIRE

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STOVE COMPANY

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GAS news

Gas measurement report published by AGA

"Orifice Metering of Natural Gas, Gas Measurement Committee Report No. 3" has just been published by the American Gas Association. This manual covers recommendations relating to the use of certain types of orifice meters used in the measurement of natural gas.

Report No. 3 will supplement Report No. 2, which was first published in 1935. Since 1948 extensive additional research has contributed to the new material included in Report No. 3. In 1953 a supervising committee for Pipeline Research Project NX-7 was organized for the purpose of preparing Gas Measurement Committee Report No. 3 in the light of the results of this research.

Generally all the data in this report are quite similar to those included in Report No. 2 except that new data, based on this research, have been added to cover a much wider range of conditions.

Report No. 3 includes data on larger diameter and heavier wall thickness metering runs, details on specifications and tolerances of orifice metering installations, and a method of evaluating supercompressibility factors.

The pressure base for the basic orifice factors has been changed from 14.4 to 14.73 psia; however, a table is given which expedites the computation of gas flow in terms of any contractural pressure base.

Copies of this report, priced at $2.50, can be ordered from the AGA, 420 Lexington Ave., New York 17.

New venting standards adopted by Los Angeles

New specifications that promise homeowners greater efficiency in gas heating with vented recessed wall heaters and set new industry standards have been adopted by the City of Los Angeles.

The adoption, voted by the board of building and safety commissioners, was the result of extensive research conducted jointly by the city and the gas industry, with vent manufacturers also cooperating.

"Gas heaters and gas heater vents installed according to the new regulations will be safe against fire and the overheating of plaster walls," said Gilbert Morris, city superintendent of building and safety. City Research Engineer Vivian Rapp, who served on a joint committee with gas industry experts and drafted the report recommending the improved standards, said he was in complete agreement with committee tests and findings.

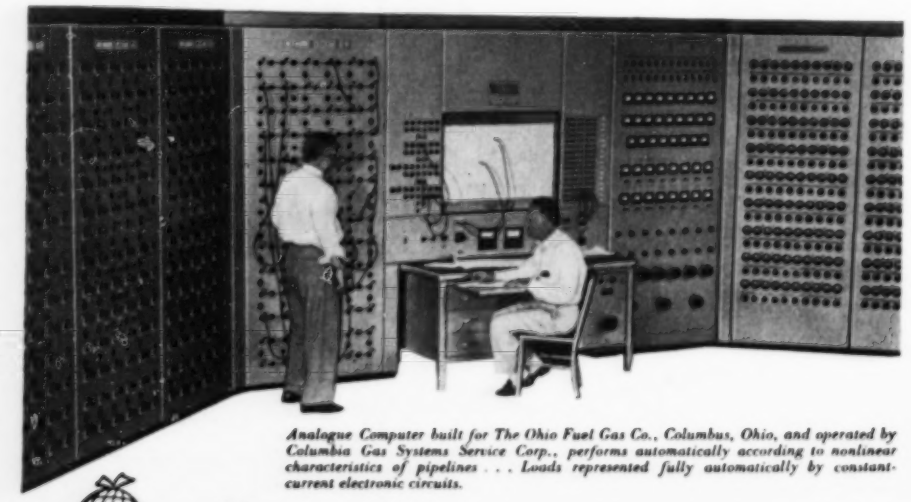
Paul Hammond, chairman of the PCGA heating division, said the changes will have national significance since the AGA was also represented on the Los Angeles committee. It was the national recommendations of the AGA against certain practices that the Los Angeles committee used as a basis for its research.

The recommendation reads as follows:

Recommendation No. 1—Effective Aug. 1, 1955.

A. Type BW gas vents shall be installed as follows:

1. The vent shall have not less than ⅜-in. clearance at all points. No lesser clearance shall be approved.



Analogue Computer built for The Ohio Fuel Gas Co., Columbus, Ohio, and operated by Columbia Gas Systems Service Corp., performs automatically according to nonlinear characteristics of pipelines . . . Loads represented fully automatically by constant-current electronic circuits.

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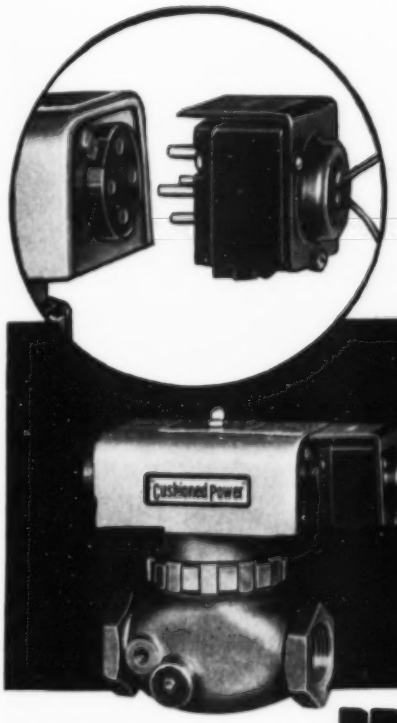

It's the talk of the industry—it's new, different, better. All the facts are yours on request—send for descriptive literature today.

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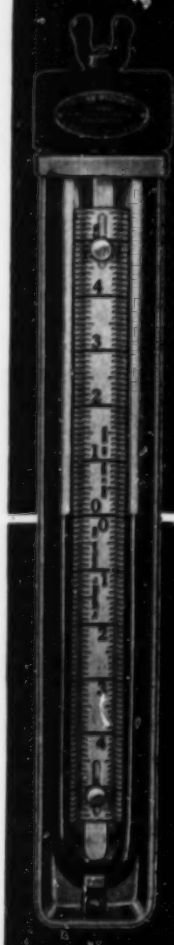
with simplicity and economy

AT LOWEST COST . . . this Meriam Manometer offers high accuracy. The Meriam B-1103 is the easy-to-use, always dependable form of pressure or flow instrumentation. Pressures to small fractions of an ounce are read directly, accurately . . . without calibration or instrument adjustment . . . with complete enduring manometer reliability.



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news • *Continued*

2. The stud space in which the vent is located shall be free from obstruction at all points and open into the attic space. No plaster keys shall be permitted in this space. Where perforated lath or metal lath is used, sheet aluminum, galvanized steel, tin plate, or equivalent not less in thickness than 0.012 in. shall be nailed to the studs to form a barrier between the lath and the vent space.

3. A metal sleeve not less in thickness than 26 gauge and of the same area as the studding space shall extend around the vent from the bottom edge of the ceiling joist into the attic space to a point 12 in. above the top of the ceiling joist; or, to a point 2 in. below the roof sheathing whichever is the lesser.

4. Spacers shall be installed at each vent joint in the wall space.

5. Vents shall be rejected if the outer wall is bent, dented or otherwise damaged to the extent that clearances are impaired or if the inner wall is distorted to the extent that the area is reduced.

6. Where a vent is to be placed in an exterior wood framewall, sheet metal not less in thickness than 28 gauge shall be nailed to the outer faces of the studs to separate the vent space from building paper, and separate the heater from the building paper.

B. Type B. vents shall be installed under the following conditions:

1. Type B. cement asbestos vents shall be installed with not less than 1½-in. clearance at all points.

2. Type B. vents approved for 1-in. clearance shall be installed with not less than 1-in. clearance at all points.

3. Spacers shall be installed at each vent joint occurring in a framed or furred space.

4. Plaster keys will be permitted.

C. Vented recessed heaters shall not back into a linen cabinet. Where a vented recessed heater is located in a closet wall, the inner side of the wall section directly behind the heater shall be faced from floor to ceiling with galvanized iron not less than 28 gauge in thickness, or with aluminum not less than 30 gauge in thickness.

D. Where a vented recessed wall heater is installed in an existing wood frame wall, the wall shall be completely opened on one side from floor to ceiling.

E. That an ordinance amendment be drafted for later consideration to require additional safeguards for self-contained heating units installed in restricted spaces such as hallways.

Recommendation No. 2—Effective Jan. 1, 1956.

A. The approval requirements on type BW vent shall be revised to require that:

1. The outer casing of double wall metal vent shall be constructed of galvanized steel not less than 28 gauge in thickness.

2. The inner conduit, when made of metal, shall be constructed of 2S or 3S

DESIGNED for quick, low cost trench digging for foundations and all types of service lines.

LADDER type permits efficient operation in the closest quarters and under difficult conditions.

CUTS up to 5 ft. in depth in 8" to 12" widths; 4 ft. in 14" and 16" widths; straight and clean.

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The 403 is a small, easy-to-maneuver machine for digging water, gas, sewer, building foundations . . . Low bearing electric or telephone lines and for pressure to avoid damage to lawns or walkways . . . Easily transported from job to job and will travel over almost any type ground. Digs a clean, straight-sided trench with squared corners. Complete details from your distributor.

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aluminum or equal in corrosion resistance and .012 in. in thickness.

3. A positive hold-down means coordinated with the engagement holes for sheet metal screws in the header plate of the heater shall be provided.

4. If the inner conduit is made of metal, the bottom edge shall be reinforced to minimize distortion.

5. A test for displacement of the vent pipe from the header plate due to a vertical upward pull will be required.

B. Only vent pipe listed by an approved testing agency as type BW may be used between wall studding having a nominal 2 in. x 4 in. dimension.

Recommendation No. 3—Effective Jan. 1, 1957.

A. The approval requirements on vented recessed heaters shall be revised to require that:

1. The temperature of the circulating air at the discharge opening shall not be in excess of 290° F above room temperature.

2. The average temperature of the flue gases from a recessed heater shall not exceed 380° F above room temperature with the flue open.

3. The average temperature of the flue gases from a recessed heater shall not exceed 480° F above room temperature when the flue is partially or completely blocked whichever results in the worse condition.

B. Only vented recessed heaters listed by an approved testing agency as complying with the above requirements may be installed.

Executive sees high level of building continuing

The nation's economy holds ample promise for a continued high level of building activity, according to L. M. Cassidy, chairman of the board of Johns-Manville Corp.

In fact, the nation has a tremendous job ahead in rebuilding the country, he believes.

"It will require a stupendous effort on our part if we are to solve the twin problems of shelter and mobility. But it is this all-out effort to solve them that will constitute the prime-mover that will enable our economy to perform on a scale big enough to support 200 million people and a labor force of 80 million or more," he told the Eastern Mortgage Conference, meeting in New York on May 2.

Mr. Cassidy believes that what the people will want most 10 to 12 years from now is not more or better food and clothing but a rebuilt America. "It is my belief that a home, one of the prime requisites of man, represents more opportunity for attractive improvements than any other item that competes for the consumer's dollar. To-

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Here the Hydrocrane moves through a city park. Once on the job, it sets up in a couple of minutes — is ready to leave in equally short order.

HYDROCRANE TURNS OVERHEAD INTO OUTPUT

The quicker you get there the sooner you can handle emergency line repairs or start on your regular digging and setting jobs. That's why Hydrocrane-Hydrohoe owners appreciate the 50-mph travel speed of this compact traffic-master. It's Hydrocrane design that makes this travel speed possible. Hydraulically operated outriggers relieve truck chassis of work strains on heavy lifts permitting use of a lighter, faster truck — one that costs less to buy and maintain. Telescoping boom fits snugly over cab and rests on a strong rack instead of bobbing out behind. Because of low superstructure, you can drive the Hydrocrane through underpasses with 12-ft. clearance.

TRY IT YOURSELF

Ask your Hydrocrane distributor to demonstrate the smooth all-hydraulic Hydrocrane or Hoe on one of your digging or lifting jobs. Then get behind the wheel and drive it yourself. Find out how you can turn costly overhead time into dollars saved. 76H55

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YEARS OF SERVICE
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This Hydrohoe, equipped with special utilities dipper, is handling a leak repair job. Wrist-action dipper is shown rotated to its forward position, 50° ahead of handle. Dipper is also rotatable 45° behind handle or a maximum of 95° for its complete arc.

day, millions of American families would like better, more spacious, modern and pleasantly located homes."

Nearly three-quarters of the non-farm families in America are getting more than $4000 a year, with which they can afford a $10,000 house. In 1939, only a quarter of these families could afford the equivalent house. Today, more than half of the non-farm families earn more than $5000 a year. They can, therefore, afford a $12,500 house, reported Mr. Cassidy. For that price the home-building industry can give excellent value in most parts of the country.

PG&E's new pipe yard now in operation

Thousands of feet of ready-to-install pipe of dimensions up to 12 in. are beginning to come off the assembly line of Pacific Gas & Electric Co.'s new Decoto pipe yard.

When pipe is delivered to the Alameda county yard from factories, it is put through the assembly processing line to be dried, pellet-blasted and then given three enamel-and-felt coats before being stored on racks for shipment as needed.

The plant eventually will have a capacity of between 40,000 and 50,000 ft per eight-hour day, or about 8 to 10 million ft a year. When in full operation, it will process pipe of all sizes used by the company, from ¾-in. service laterals up to large transmission line diameters. The plant finally will represent an investment in excess of $800,000.

During regular operations, a staff of about 35 men will be stationed at Decoto, but the number may be increased to about 50 during peak periods after all machines are in service. Three machines presently are installed and space is provided for future expansion of the plant.

API issues 3rd edition of field-welding standard

The American Petroleum Institute has announced the publication of a third edition of the "Tentative Standard for Field Welding of Pipelines," incorporating certain changes resulting from comments on the second edition issued in February 1954.

Principal changes are in the welding section where rather extensive revisions have been made. The important additions to this revision are the procedure qualification requirement and sketches of test specimens.

Copies of "API Standard 1104, Third Edition, Tentative Standard for Field Welding of Pipe Lines," may be ordered from J. A. McNally, American Petroleum Institute, 50 W. 50th St., New York 20. Price: 50 cents.

Louisiana parish seeks enforcement of SEC ruling

A petition has been filed urging the Louisiana PSC to seek enforcement of the SEC ruling that the Louisiana Power & Light Co. must sell its gas distributing facilities in Louisiana. The petition was filed by attorneys for the Jefferson parish police jury.

The commission is asked to reverse its stand before the SEC in Washington and make it possible for the parish to buy the gas properties.

Louisiana Power has proposed that it be permitted to sell its gas properties to a subsidiary, Louisiana Gas Service Corp. The Jefferson parish petition said that such a sale would continue the firm's indirect ownership.

The Louisiana PSC entered the fight by intervening with the SEC and asking the commission to modify its order to permit the operation of both gas and electric systems by the one company.

FIRST AID FOR INDUSTRIAL PILOTS

The symptoms are simple and easy to spot
A pilot that's out or burning too hot
A ledger that shows gas costs are up
Primarily due to a pilot's hiccup

Maxine knows the cure to this little worry
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Deliveries are prompt and prices are down
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Maximum outlet pressure about 22" W.C. with a maximum inlet pressure of one psi.

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Boiler installations reached new high in 1954

A new high for installation of hot water and steam heating systems in new residences was achieved in 1954, according to the Institute of Boiler and Radiator Manufacturers.

Complete tabulations show home heating systems using boilers of all types were installed in 30 to 35% of new homes built in 1954, a gain of about 5% over 1953.

The figures are based on industry boiler shipments, which show cast iron boiler tonnage alone up 8.40% over 1953—and estimates of installations in new housing as compared to older homes. The results also indicate that of total installations in both new and old homes, boilers were installed in about 24% as compared to 76% for hot air furnaces, electric heating units, space heaters and other devices.

The lower percentage of boiler replacements in old homes reflects the longer life expectancy of boilers as compared to hot air furnaces, and consequent lower replacement rate.

State commissioners plan regulation panel for meet

To regulate or not to regulate producers of natural gas is a controversial question, which, in recent years, has been before the courts and Congress almost continuously. According to W. F. Whitney, president of the National Association of Railroad and Utilities Commissioners, this controversy will be given featured billing by the regulators themselves at the NARUC 67th annual convention to be held in Asheville, N. C., Oct. 24-27.

On Oct. 26 an all-forenoon, 6-member panel discussion of regulation of natural gas has been arranged. Panel members will present the FPC viewpoint, the viewpoint of producers and of the producing states, and the viewpoint of the consuming states. Each panel member is an expert in his field of discussion.

The panel will discuss the impact of regulation upon producers and suppliers of natural gas, the producing states, conservation, exploration for new gas supplies, price of gas to consumers, and utilization of gas.

Audience participation in a question-answer period will be held during the panel session.

President Whitney emphasized that notice of guests' intentions to attend the convention, and requests for hotel reservations, should be made immediately by writing to Commissioner Edward H. McMahan, North Carolina Utilities Commission, Raleigh, N. C.

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Regardless of pulsations or other causes of ink failures this new Never-Dry Pen will make clean and complete records. Ink supply lasts for several months without refilling reservoir. Capillary tube from ink bottle placed in instrument case feeds pen with continuous flow. Closed system sealed from atmosphere prevents clogging and dirt accumulation.
Weight of pen is constant at all times thus insuring extreme accuracy. No slopping or dripping. Stainless steel construction—no corrosion. When ordering, specify make and type of recording instrument.
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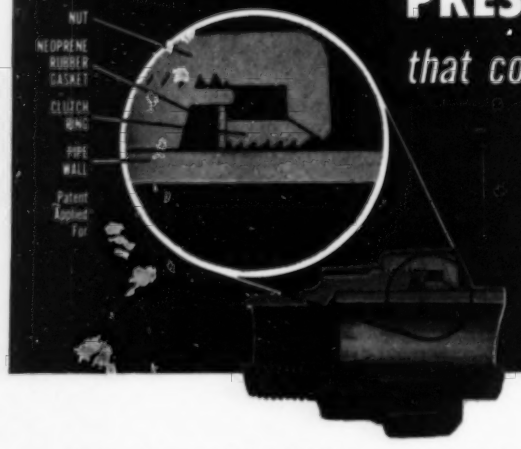

Telsco Long and Short Couplings, Adapters, 90° Elbows, and Tees, ½ through 2 inches.

Use Telsco Fittings on Plastic Pipe, too—Metal Stiffeners for this application are available.

The unique sealing principle used in Telsco Threadless Fittings concentrates great pressure, under containment, on *all sides* of a *small* rubber gasket (See cross section). Under this tremendous pressure, confined in a small area, the gasket forms a tight seal against leaks.

At the factory every Telsco Fitting gets a 90-pound air pressure test, under water—assuring a sound casting every time.

Telsco Fittings do not insulate. Instead they conduct static electricity without the time, effort and cost of bonding every connection.

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LOWEST COST TRENCHING FOR PUBLIC UTILITY WORK

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Digs 3" to 6" Trenches Any Depth to 36"

For low-cost general light trenching. Self-contained, operates under its own power. Digs clean, even trenches to 36" depth. Lightweight, mobile, low operating and maintenance costs. Easily transported from job to job. Several models.

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- *Surveying*
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HIGH QUALITY ANODES

PIPE LINE *Anode* CORPORATION
25TH WEST AVENUE AND SAND SPRINGS RD.
P. O. BOX 996 • TULSA, OKLAHOMA

GAS calendar

June

1-2..Tenth Annual Short Course in Gas Technology — Texas College of Arts & Industries, Kingsville, Texas.

5-9..Canadian Gas Association Annual Meeting—Sheraton-Brock Hotel, Niagara Falls, Ontario.

7-9..Mid-West Gas Association Gas School & Conference — Iowa State College, Ames.

9-10..Natural Gas & Petroleum Association of Canada — Royal Connaught Hotel, Hamilton, Ontario.

13..Southeastern Gas Association Short Course in Gas Technology (ending July 9)—Raleigh, N. C.

17..NEGA Home Service Group—Lynn Gas & Electric Co., Marblehead, Mass.

21..NEGA Accounting Division—Wachusett Country Club, W. Boyleston, Mass.

26-28..Wisconsin Utilities Association Accounting Section — Dell View Hotel, Lake Delson, Wis.

27-28..Michigan Gas Association—Grand Hotel, Macinac Island, Mich.

July

18..Southeastern Gas Association Short Course in Gas Technology (ending Aug. 13)—Raleigh, N. C.

August

15..Southeastern Gas Association Short Course in Gas Technology (ending Sept. 10)—Raleigh, N. C.

29-31..15th Annual Appalachian Gas Measurement Short Course—West Virginia University, Morgantown, W. Va.

September

7-9..Mid-West Gas Association Gas School & Conference — Iowa State College, Ames.

9..New Jersey Gas Association —Hotel Monmouth, Spring Lake, N. J.

11-13..INGAA Annual Meeting — Jasper Lodge, Alberta.

14-15..AGA Accident Prevention Conference — Marion Hotel, Little Rock.

16-17..Maryland Utilities Association Fall Conference—Virginia Beach, Va.

27-30..International Gas Union 6th Conference — Hotel New Yorker, New York.

October

12-14..GAMA Annual Meeting — El Mirador Hotel, Palm Springs, Calif.

17-19..1955 AGA and PCGA Convention—Los Angeles.

24-27..National Association of Railroad & Utilities Commissioners—Asheville, N. C.

November

13-18..American Society of Mechanical Engineers—Congress & Hilton Hotels, Chicago.

14-17..American Petroleum Institute —San Francisco.

16-18..Southeastern Gas Association —Roanoke Hotel, Roanoke, Va.

28-30..SGA Advisory Council & Management Conference — Grand Hotel, Point Clear, Ala.

1956

March

19-21..MidWest Gas Association — Hotel Fontenelle, Omaha.

22-23..New England Gas Association Annual Meeting — Hotel Statler, Boston.

April

4-6..AGA General Management Section Spring Conference—Conrad Hilton Hotel, Chicago.

16-19..AGA Sales Conference on Industrial & Commercial Gas —Hotel Roanoke, Roanoke, Va.

16-18..National Conference of Electric & Gas Utility Accountants — Hotels Biltmore and Commodore, New York City.

19-21..GAMA Annual Meeting — The Greenbrier, White Sulphur Springs, W. Va.

23-25..Southern Gas Association Annual Convention—Dallas.

May

7-10..AGA Distribution, Motor Vehicles, and Corrosion Conference—Congress Hotel, Chicago.

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A SIMPLE SOLUTION for one of the GAS INDUSTRY'S *most trying problems*

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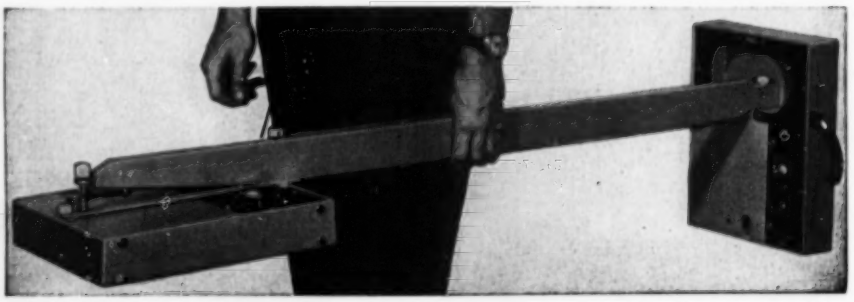

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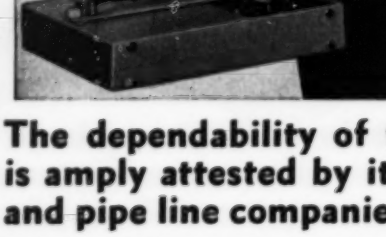

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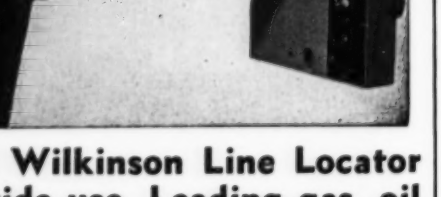

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Federal court stays clear of Arkansas utility issue

Leaving utility rate problems in Arkansas to the State Public Service Commission, a three-judge federal district court unanimously decided on May 2 in Little Rock to dismiss a suit in which a utility sought to increase its rates despite a PSC disapproval last year.

General Telephone Co. of the Southwest had asked for a federal injunction to stop the PSC from interfering with a proposed $300,000 rate increasee. The utility contended the PSC disapproval of higher rates in effect deprived the firm of its property rights in violation of the federal constitution.

John R. Thompson, counsel for the commission, said unless the federal court dismissed the case, it could plan on setting rates from now on. "If you set this case for trial," he said, "you will upset every rate basis in Arkansas."

General Telephone had a remedy in state courts, Mr. Thompson added, and the firm should refile its rate increase request and produce records to back up such a request.

Appliance shipments set new records in March

Shipments of gas-fired appliances were all up in March, with water heaters and gas furnaces setting new records for the month.

Not only were March shipments of water heaters the highest on record for that month (259,600), but an all-time first-quarter high was set when 674,300 units were shipped for a 27.9% increase over last year.

Gas-fired warm air furnace shipments set two new records during March, when 58,200 units were shipped for a gain of 45.9% over last March and the first-quarter shipments reached 155,000 units, an increase of 51.2% over the first quarter of 1954.

Gas ranges also continued to show gains, with March registering an increase for the fifth month in a row. Shipments totaled 217,000 in the third month of this year, compared to 188,200 last March, a 15.3% increase.

GAS news notes

The price index of natural gas common stocks after advancing to a new peak during the month of April experienced a moderate decline at the close of the month. At the end of the current month the index was 19.1% higher than on the comparable day one year

prior but was 1.5% lower than the peak occurring during the month. The average yield was lowered from 4.90% on April 30, 1954, to 4.29% on the peak date, subsequently rising to 4.41% on April 29, 1955, as a result of the decline in prices and an increase in dividend payments.

The first annual Alexander Hamilton Free Enterprise Award for service in public relations has been awarded to Robertshaw-Fulton Controls Co.'s Grayson Controls division, Long Beach, Calif.

The award is for "the best year-round public relations job in pointing up the advantages of America's free enterprise system," and is presented as a highlight of the annual observance of Invest in America Week.

"Sales of gas heating equipment have increased substantially following our rate reduction on April 1, 1955," President John E. Heyke of Brooklyn, N. Y. Union Gas Co. told stockholders attending the annual meeting last month. Mr. Heyke also stated that the company has recently reduced rates for summer water heating and spring and fall heating in apartment houses. Because these lower rates place gas in a very good competitive position, large sales volumes are expected from this source.

Commonwealth Steel & Supply Co., Los Angeles, has been acquired by Howard Supply Co. Commonwealth is a distributor of steel, nails, wire and fasteners. The company will continue to operate as a wholly owned subsidiary of Howard Supply.

Peoples Gas Light & Coke Co.'s board has authorized the issuance of an estimated 111,836 additional shares of the company's capital stock. Proceeds from the sale estimated at $15.5 million, will be used to repay $6 million of bank loans incurred to purchase stock of Peoples Production Co. and for purchasing additional stock of that company; to finance a portion of the expansion cost of the Herscher underground storage facilities; and to enlarge, improve, and replace portions of the Peoples Gas distribution system.

Consolidated Edison Co. of New York is renting three electronic accounting machine. An IBM 705 will be used in the field of general accounting and two Remington Rand Univacs will be used in the area of customer billing.

The heat and mass flow analyzer laboratory, a division of Columbia University's School of Engineering, is making its services available to the gas industry for assistance in solving its heat

Saves 6 men, 4 tampers, 2 compressors and small dozer with one-man-operated "80-W"

VAN DOREN BROTHERS of Richmond, Virginia recently backfilled and compacted approximately two miles of trench, 2 feet wide and 4 feet deep, for a 6-inch gas line with just one man and one machine, a Cleveland "80-W" backfiller.

Before the Van Dorens purchased their "80-W" they used 7 men, a rubber-tired dozer, 2 compressors and 4 air-driven tampers for backfilling and compacting on jobs of similar size and type. The one-man-operated "80-W" did the complete job in less time than the 7-man crew formerly required on comparable jobs. "It's a great time saver," was F. M. Van Doren's comment on its performance.

On a previous job their Cleveland backfiller had saved them considerable time and money on a 12-inch water line trench, averaging approximately 6 feet deep, by its unique ability to backfill spoil deposited on a down slope on the far side of the trench, while simultaneously tamping it to the state of Virginia's rigid compaction specifications.

The "80-W" also does an outstanding job of side-crane work, lays pipe, pulls crossings, sets hydrants and valves, pulls sheathing, loads and unloads pipe, etc. Despite its ability to perform all these operations—and do an outstanding job on *each* of them—the "80-W" is easy to operate. The Van Dorens' operator learned to operate it with high efficiency after only two days training on the job.

Investigate this remarkable time, labor and machinery saving tool now—so that you, too, can realize its outstanding benefits on your next job.

See your local distributor for the full Cleveland story or write direct to:

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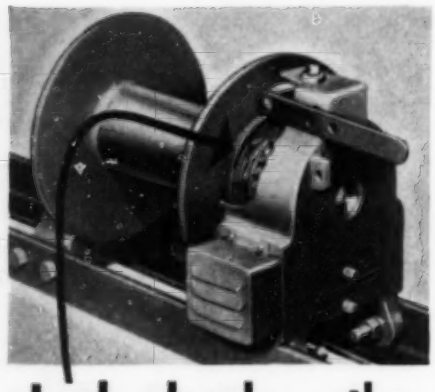

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Here, at last, is an improved light-duty Gar Wood winch that positively ends the old-time headaches of sticking, freezing, rusting — because all moving clutch parts are *fully enclosed and running in oil.* Neither weather nor dirt can ever get in. Your operator also has much *safer control of the load,* thanks to Gar Wood's exclusive self-energizing safety brake, and time-tested backdraft clutch, which eliminates the hazard of sudden slippage.

More GW plus values

New rust-proof aluminum housing means lighter weight, longer life... dissipates heat much faster than steel. In addition, extra rugged base angles insure a margin of safety many times the rated capacity of the winch. New "built-in" rope clamp also simplifies attaching and changing rope... eliminates U-bolts and other projections that tend to foul spooling. See these great new 7000-lb. winches – standard or low mount – at your Gar Wood distributor today.

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transfer and gas flow problems. The analyzer, an analogue computer which has been developed continously in the laboratory over a period of years, is available for technological and industrial use. Inquiries should be directed to Dr. Victor Paschkis, Columbia University, New York 27.

Consumers Power Co., Jackson, Mich., has sold its gas manufacturing and distribution system in Manistee to Raymond S. Weidenfeller and Mahlon R. Stewart of Sault Ste. Marie, Mich. Mr. Weidenfeller is an officer of the company that bought the Sault Ste. Marie gas system from Consumers several years ago.

Lone Star Gas Co.'s purchase of properties operated by Spearman Gas Co., serving Eldorado, Okla., has been confirmed, although final consummation of the transaction is subject to authorization and approval by the Oklahoma Corporation Commission and the FPC. No change in operating personnel is contemplated at the time Lone Star takes over the new property.

Formation of a Utah Gas Service Co. to provide natural gas service to Vernal, Moab, and Monticello has been proposed to the Utah Public Service Commission. Loran L. Laughlin, president of Goodland (Kan.) Natural Gas Co., said the gas would be purchased from Pacific Northwest Pipe Line Corp. Greeley (Colo.) Gas Co., which also has applied for permission to serve Vernal, won permission before the hearing began to intervene.

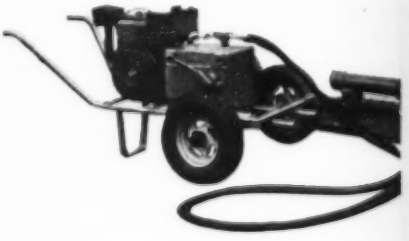
Subsequent to the announcement that the Bryant division of Carrier Corp. is moving its home offices from Cleveland, Ohio to Indianapolis, Ind., the firm acquired an industrial site for administration, sales, engineering and research offices in that city. Acquisition of the property will permit permanent establishment of headquarters close to the manufacturing plant.

Rockwell Manufacturing Co. has changed the name of its Canadian subsidiary—Callander Foundry and Manufacturing Co. Ltd., Guelph, Ontario—to Rockwell Manufacturing Co. of Canada Ltd.

Niagara Mohawk Power Corp. will make natural gas available to six more central New York communities. Gustav F. Watters, vice president of the company, said that by next fall gas services will be extended to Adams, Adams Center, Camillus, Cicero, Jamesville and Minoa.

"Pipe installation time and labor costs cut about 50% with Greenlee Pipe Pusher"

That's what a leading eastern utility reports as its experience with a GREENLEE Pipe Pusher on jobs as shown above. Let this remarkable tool make big timesavings and reduce job costs for you, too. With the GREENLEE Pusher, *one* man pushes pipe *under* streets, walks, floors, railways, lawns, etc. Eliminates extensive trenching and time-consuming tearing up, tunneling, backfilling, repaving. Often pays for itself on the first few jobs. Two models: No. 790 for pushing ¾" to 4" pipe; No. 795 for larger pipe and concrete ducts.



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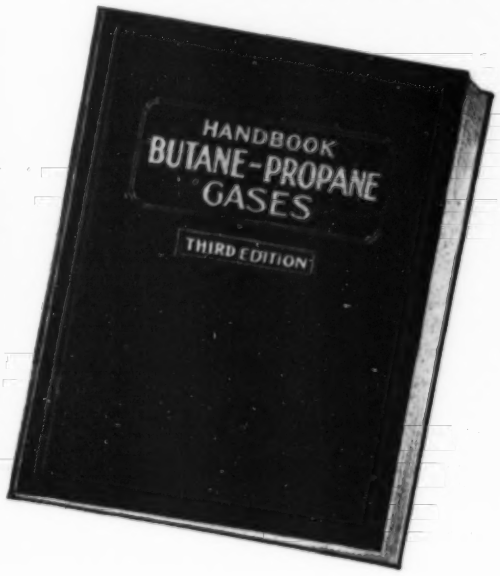

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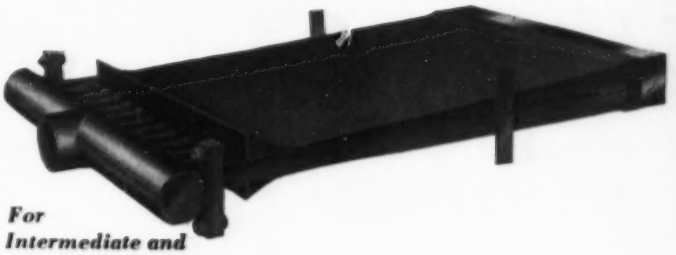

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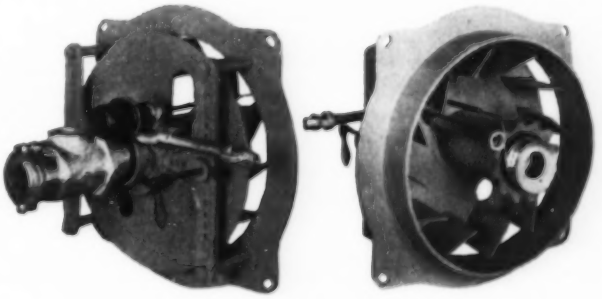
This unique application of the *Venturi* principle has resulted in a high input burner that can be installed through *very* narrow rectangular furnace openings.

It is recommended for inter-tube firing; firing in a horizontal plane through small openings over coal grates; firing in a vertical plane on either side or on a horizontal plane over a stoker or oil burner; and also for use in all types drying kilns.

It is small in size, and light in weight, with excellent turn-down without flash back; stable flame retention even at high inputs—low noise level.



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For High Pressure Gas with Combination Oil

When high pressure gas is available the 5 sizes of Series R Burners provide inputs from 2,000,000 Btu/hr/burner at 1 psi to 50,000,000 Btu/hr/burner at 10 psi.

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Promotions

N. R. Sutherland

J. B. Block

Pacific Gas & Electric

Pacific Gas & Electric Co., San Francisco, has promoted JAMES B. BLACK to chairman of the board of directors, and named NORMAN R. SUTHERLAND as president and general manager. ROBERT H. GERDES was named executive vice president and general counsel.

R. H. Gerdes
PG&E

A. E. Englebright
Honolulu

A. E. ENGLEBRIGHT, who has been vice president and general manager since 1948, has been elected president of both Honolulu Gas Co. and Pacific Refiners Ltd. He succeeds E. E. BLACK, who becomes chairman of the board of both companies.

Several promotions have been announced by Peoples Gas Light & Coke Co., Chicago. BERNARD H. WITTMAN and EMORY A. MANLOVE have been elected assistant vice presidents; JOSEPH KAHN is manager of the industrial sales department, succeeding DENISON W. CHAPMAN, who has retired; ROBERT L. INGEMAN is assistant manager of the industrial sales department; HAROLD C. BROWNELL succeeds Ingeman as assistant to the sales engineering manager; and ARTHUR A. GERVAIS succeeds Brownell as supervising engineer of the south sales section.

ELLIOTT CAMPBELL, formerly manager of distribution, has been promoted to assistant to the director of operations for Milwaukee (Wis.) Gas Light Co. Other promotions include ELLSWORTH UNGETHUEM, manager of gas supply

and distribution; ROBERT PROSSER, manager of distribution, construction and repair; HOWARD KOWNESTROT, superintendent of maintenance; KEITH CHEN, superintendent of corrosion-mitigation operations.

Coleman Co., Wichita, has established a utility operations department within the sales department with CLIFFORD E. HALL heading the department. ROBERT H. LOWE and L. T. ASH will assist him.

NELSON E. DAVENPORT, sales engineer in Rockwell Manufacturing Co.'s meter and valve division district office at Atlanta, has been named assistant gas products manager with headquarters in Pittsburgh.

JEROME P. HAPP has rejoined North Shore Gas Co., Waukegan, Ill., as general sales manager.

JOHN M. WILSON has been named chief engineer of the development and design division of the engineering department of Minneapolis-Honeywell's Brown Instruments division.

FRED C. EGGERSTEDT JR. has been elected an assistant vice president of Long Island Lighting Co., Mineola, N. Y.

T. N. H. MARTIN, formerly district manager of Hollywood, Fla., has been promoted to sales manager for Peoples Water & Gas Co., North Miami, Fla.

C. I. WALL has been elected president of Pioneer Natural Gas Co., Amarillo, and K. B. WATSON secretary.

New Jersey Natural Gas Co., Asbury Park, has elected SIDNEY M. SCHREIBER, member of the law firm of Schreiber, Lancaster & Demos, and WILLIAM ABERNETHY, head of Sanitary Supply Co., to the board of directors.

FRANK TANLER has been named to the newly created post of national sales representative of White-Rodgers Electric Co.

WILLIAM W. BABCOCK has been elected vice president in charge of sales, public relations and rates of the Central Illinois Light Co., Peoria.

SUMNER LADD has been promoted to manager of the Industrial Controls division of General Controls Co., Glendale, Calif.

East Ohio Gas Co., Cleveland, has announced the following changes: HAROLD ECKES, director of public relations, will also assume the duties of director

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- ☐ 12.6 mph mobility on rubber
- ☐ automotive steering
- ☐ truck-type hydraulic brakes
- ☐ digs up to 14½ ft. per min.
- ☐ 8 to 16 in. wide, 5 ft. deep
- ☐ positive down-crowd boom
- ☐ high-carbon cast-steel buckets
- ☐ easy-insert "Tap-In" teeth
- ☐ shiftable, reversible conveyor
- ☐ 43.6 h.p. gas engine
- ☐ 6-ft. backfill blade (optional)

Parsons rubber-tired 88 Trenchmobile is the low-cost answer on widely-scattered, small-yardage trenching jobs, where it costs more to move big equipment in and out than it does to move the dirt. This mobile trencher drives cross-town at 12.6 m.p.h. . . . digs house-to-street service connections at speeds up to 14½ feet per minute... drives on to next job without delay.

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people • *Continued*

of market research; RICHARD L. LEUSCH is assistant sales manager; and LEE CORN, sales manager, will become manager of the Warren-Niles division, replacing J. J. HENRY, who is retiring.

PAUL T. HUGHES has been named to the new post of supervisor of stores and automotive operations of Southern Counties Gas Co., Los Angeles.

KENNETH R. KNAPP has retired from the AGA Laboratories after 44 years of service to the gas industry. He has been assistant director of the laboratories since 1946.

VINCENT P. RUMELY, senior vice president and a member of the board of directors of the Crane Co., Chicago, has retired. Mr. Rumely became associated with Crane in 1937 as a production engineer.

JAMES C. STOPFORD has been named vice president in charge of manufacturing and distribution of Pacific Refiners Ltd., Honolulu.

Servel Inc., Evansville, Ind., has appointed RICHARD S. TESTUT to the new post of assistant to the president and director of business planning. The company also named WALTER A. SMITH director of purchasing.

Day & Night Division of Carrier Corp. has promoted FRANK R. SPRATT to California regional manager; LEWIS G. ELIA to the sales engineering staff; and DONALD R. STARIN to the staff of the sales engineering department.

H. J. Coombe

D. M. Forker Jr.

Wm. Powell Co.

H. JAMES COOMBE, president of the Wm. Powell Co., has been elected chairman of the board and will continue as active chief executive officer. DAVID M. FORKER JR., executive vice president, is now president.

RODNEY S. DURKEE has been elected to the board of directors and appointed to the executive committee of Dresser Industries Inc. The company also announces that H. P. BONCHER has been named operating vice president of Dresser Manufacturing division, Bovaird & Seyfang, Clark Bros. Co., Dresser-Ideco Co., Pacific Pumps Inc., and Roots-Connersville Blower division. W. D. MILLER is operating vice president of Magnet Cove Barium Corp., Lane-Wells Co., Security Engineering division, and Ideco division. Succeeding Mr. Boncher in his position as general manager of Dresser Manufacturing divison is F. G. FABIAN JR.

CHARLES C. INGRAM JR., district superintendent of the Oklahoma City district, has been elected vice president of the land and geological department of Oklahoma Natural Gas Co., Tulsa.

Consolidated Gas Electric Light & Power Co. of Baltimore has elected CHARLES P. CRANE chairman of the board in addition to renaming him president. J. PIERRE BERNARD was elected an director and MASON C. ALBRITTAIN was elected vice president and general sales manager.

LLOYD R. EARL, president and a director of United Concrete Pipe Corp. of California, a wholly owned subsidiary of United States Pipe & Foundry Co., has been elected a director of the parent company.

Gar Wood Industries Inc. has promoted DANIEL J. SHULKATIS to the position of service manager of its St. Paul Hydraulic Hoist division at Mattoon, Ill. The company also announces that E. B. HILL, director of sales and advertising, has resigned.

New faces

Monte Weaver
Nevada Southern

J. L. Sanders
Nevada Natural

MONTE WEAVER has joined Nevada Southern Gas Co., Las Vegas, Nev., as district manager. For the past two years he has been zone sales manager for Serval Inc. in the air conditioning division.

JAMES L. SANDERS has joined Nevada Natural Gas Pipeline Co., Las Vegas, as an engineer. He has been an engineer with El Paso Natural Gas Co. for the past six years.

GAS

JUNE 1955

Expansion did this! Movement between the end of the 30-in. pipe and the 12-in. blowdown connection opened this crack halfway around the circumference of the connection. Extensive investigation and experimentation that led to satisfactory measures for rectifying the trouble are discussed in this article. (Photo is identified in the article as Fig. 3.)

How to solve expansion problems in high pressure lines

By **E. A. WALLACE** • Southern Counties Gas Co.
and
H. C. VANDER HEYDEN • Southern California Gas Co.

THE original 30-in. line was installed in 1947 as the California section of the first Biggest Inch pipeline, which extends from Texas to the metropolitan Los Angeles area. The California section extends west from the Colorado river, on the Arizona-California state line, to the terminal at Santa Fe Springs, a distance of approximately 212 miles.

Subsequent looping has been completed to provide two 30-in. parallel lines except for a distance of 31.5 miles, which is still a single line. In the eastern section, the lines generally were laid in adjacent rights-of-way and are cross-connected at each mainline valve. On the original line the main sectionalizing valves and blowdown valves were placed in open-topped concrete manholes and on the parallel line the valves were buried with projected stems for aboveground operation. When the parallel line was laid, the blowdown connections on the eastern section of the original line were changed to use a common stack with the parallel line. *Fig. 1* illustrates a typical mainline valve and blowdown arrangement of the two lines.

It was just after a second increase in capacity when the facilities had been installed to raise the capacity from 405 to 555 MMcf/d that we experienced our expansion trouble. *Fig. 2* is a sketch of the eastern section of the line showing the facilities installed at that time. The original proposal had been to add 81 miles of parallel pipeline for the second increase, but because of the steel shortage resulting from the Korean affair, and the uncertainties connected

This article has been adapted from a talk presented at the PCGA transmission conference held in Palm Springs, Calif., May 2-3.

Expansion problems . . . First indication of movement was a blowdown connection failure

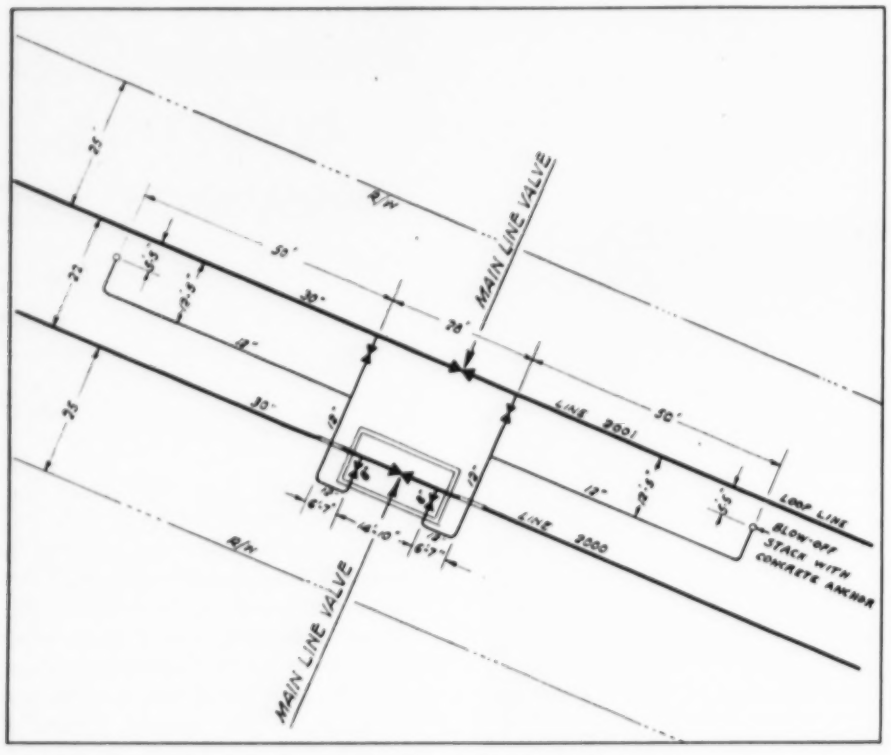


Fig. 1. Typical mainline valve and blowdown piping on the 30-in. Blythe-Los Angeles line.

with constructing an interstate pipeline over public lands at that time, the parallel pipe that could be added was limited to a 14-mile section starting at valve No. 11 and extending easterly to the tie-in near valve No. 9. Two centrifugal booster stations were installed as an alternate for the remainder of the pipe. The capacity of Blythe station was increased by adding two 1760-hp compressor units, and by maintaining the suction pressure with the installation of the 6 miles of parallel line between Blythe station and the Colorado river.

Pipeline movement

The first indication of the pipe expansion was the failure of a 12-in. blowdown connection located at the eastern end of the 14-mile loop. Referring again to *Fig. 2*, it can be seen how the blowdown piping was arranged. The failure was caused by the movement between the end of the 30-in. pipe, which was relatively unrestrained, and the 12-in. connection, which was anchored through the blowdown line to a concrete block. The failure extended around half the circumference of the 12-in. pipe at the edge of a fillet weld on a fabricated 30-in. by 12-in. tee, and opened a maximum of ⅜ in. (see *Fig. 3*).

Pressure increase

The failure occurred just a few days after the Cactus City booster station was placed in operation, increasing the pressures and temperatures in this section of the line. The pressure increase was about 100 psig, and the temperature of the Cactus City station discharge gas increased as much as 40° F above normal ground temperature. (This rise in temperature was caused by both booster stations since Desert Center station was already in service and the gas lost only one-half of the heat of compression gained at Desert Center station by the time it reached Cactus City station. Gas cooling at the booster sta-

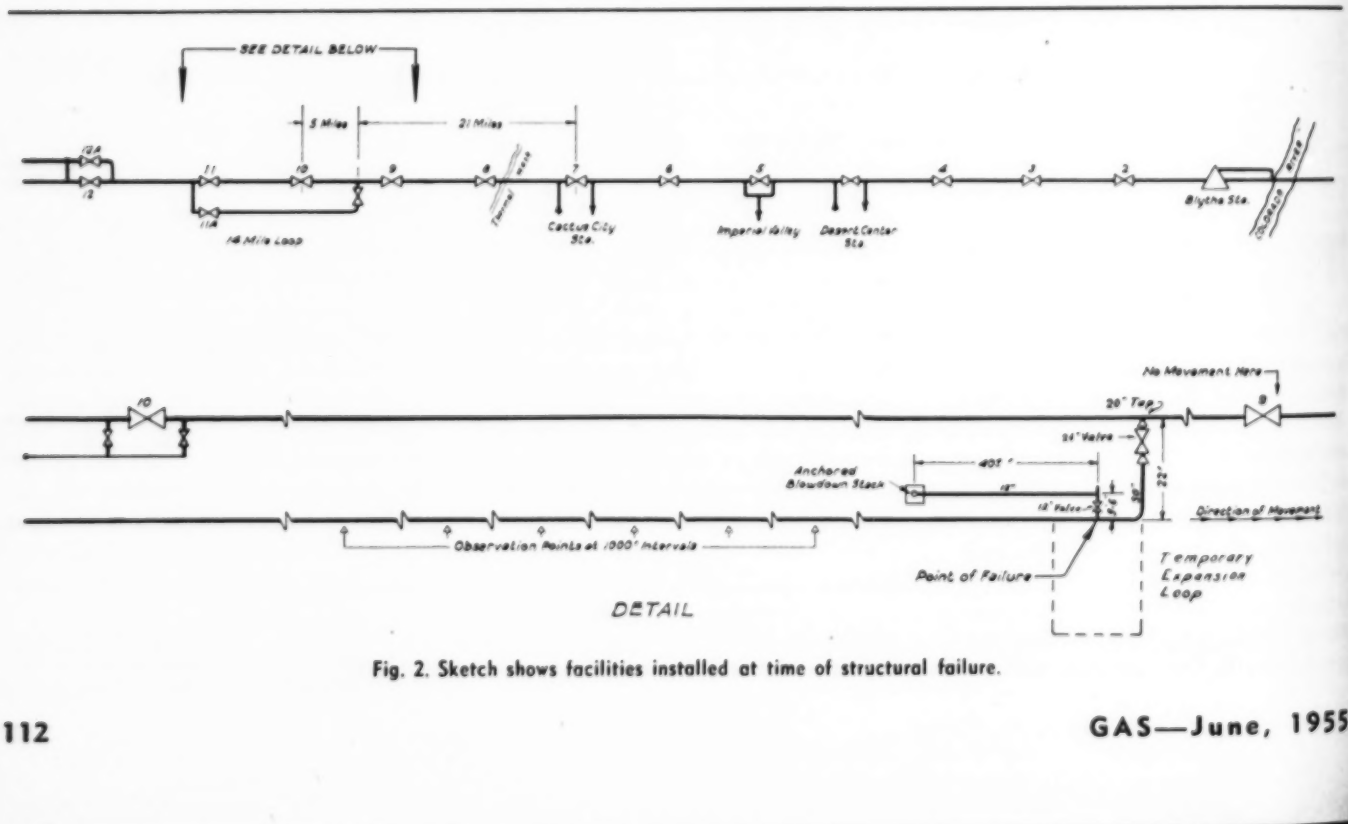


Fig. 2. Sketch shows facilities installed at time of structural failure.

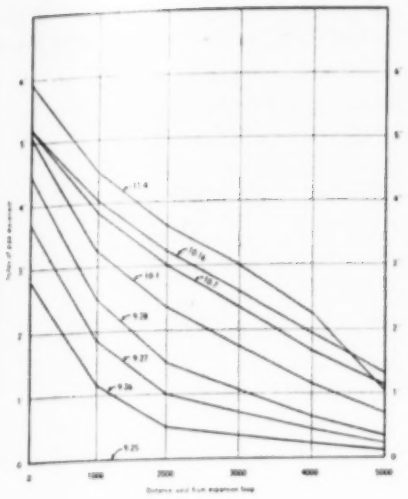


Fig. 4. Movement in expansion loop and at 1000-ft intervals west from expansion loop.

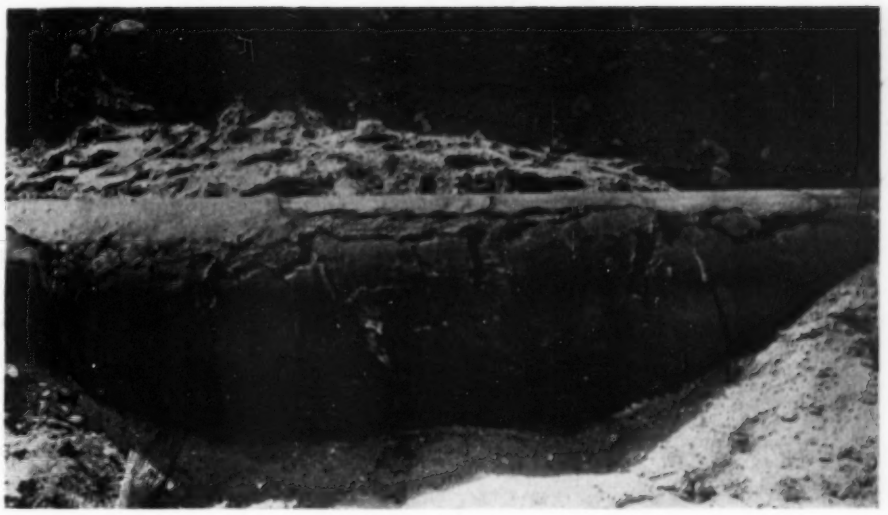


Fig. 5. Short section of exposed pipe showing type of damage resulting when part of coating was restrained and part of it was free to move with the pipe.

tions was not provided since water was not available in sufficient quantities, and since the stations were designed with gas after-cooling as an optional provision.) With ground temperatures running as high as 95° F, the added heat of compression was sufficient to heat the pipe and coating material to a temperature level where the coating material became plastic and allowed the pipe to slip inside the wrapper, thus losing the benefit of the restraint from the earth.

Forces

The forces causing the movement are believed to be due to both pressure and temperature effects, but primarily due to pressure. There was no significant movement in the original line beyond Thermal Wash, which is 6.8 miles west of the Cactus City station, and the point of failure on the loop line was located 21 miles west of Cactus City station. This led us to believe that the heat of compression remaining in the gas at the point of the loop tie-in was not sufficient in itself to cause much expansion, but contributed to the failure principally by softening the coating material, which allowed the pipe to slip inside the wrapper and expand due to the internal pressure.

At first, we were not aware that there was any movement in the original line and we were concerned only with the expansion of the 14-mile loop. The pipeline was cut to remove the broken connection and to relieve the stress on the loop tie-in. The loop tie-in moved 1⅜ in. after the cut was made. The 12-in. connection was replaced, but because of continued movement the blowdown tie was finally removed and a temporary expansion loop was installed to protect the mainline tie-in (see *Fig. 2*). Movement of the line continued even when the Cactus City station was not in operation, but movement was accelerated when the station was in operation. At the time the expansion loop was installed, five reference points were established at 1000-ft intervals, west from the point of failure. *Fig. 4* shows the amount of movement measured at these points from Sept. 25 to Nov. 4, before the expansion loop was removed preparatory to extending the parallel line eastward. From the time of the failure to the time the expansion loop was removed, Aug. 23 to Nov. 19, the east end of the parallel line had moved a total of 13 in. On the basis of the amount of movement recorded at each of the reference points, it appears that most of this movement occurred in the eastern 5000-ft section. The possibility of the slope of the ground contributing to the movement of the pipe was considered and a profile of the parallel line was prepared. Immediately to the west, there is a gradual rise of about 1% for 2000 ft, a dip of 1% for the next 1500 ft and then a gradual rise of 1% extending to a high point about 6000 ft west of the tie-in. In the next 2000 ft, there is a fall of about 1.5%. It is doubtful if this small amount of slope would have an appreciable effect on the movement of the pipe, but the change in the

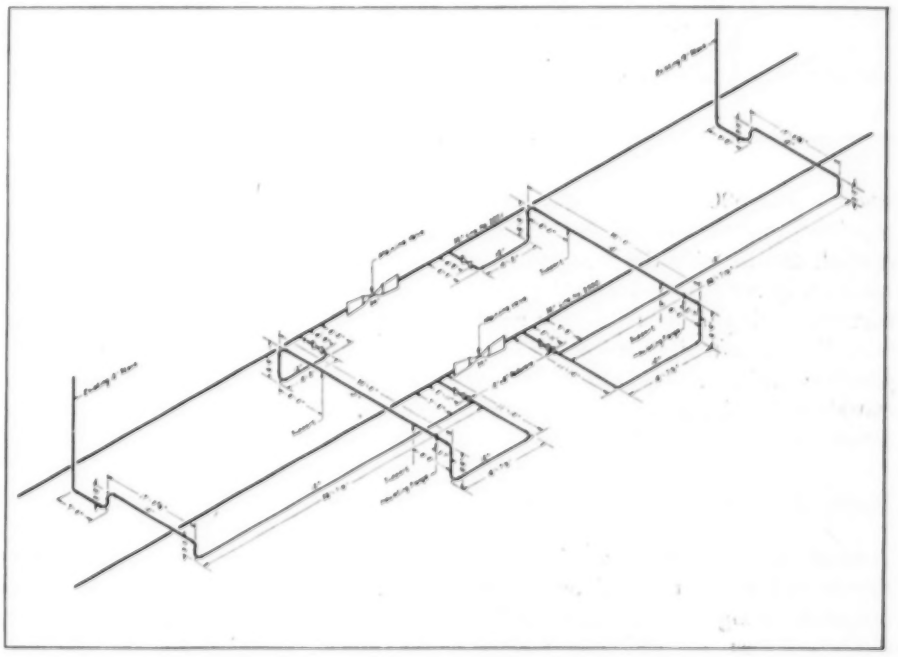
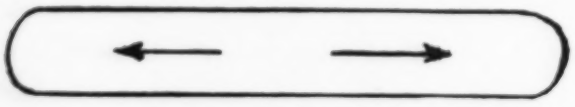


Fig. 6. Isometric drawing of proposed expansion loops.

Calculations to determine magnitude of forces involved

PRESSURE EFFECTS

1. Assume pipe with free ends, capped and unrestrained.

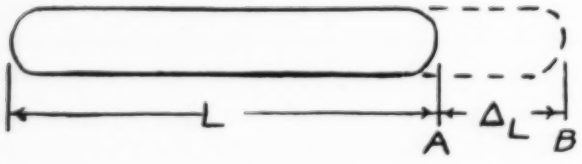


If pressure is applied internally, longitudinal tensile stress is set up in pipe wall. The force at the ends, F = total area × pressure.

For 30-in. OD × 5/16 in. wall pipe, and 800 psig, internal pressure, F = 707 × 800 = 565,000 lb.

$$\text{Stress} = \frac{\text{Force}}{\text{Metal area}} \quad \frac{565{,}000}{29.19} = 19{,}450 \text{ psi.}$$

2. This stress causes elongation in pipe from A to B.



$$\text{Unit elongation, } e = \frac{\text{Stress}}{\text{Modulus of elasticity}} = \frac{S}{E}$$

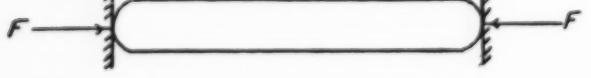
$$e = \frac{19{,}450}{30 \times 10^6} = 0.00065 \text{ in./in.}$$

Total elongation, $\Delta_L = e \times L$, length

For 1000 ft, $\Delta_L = 7.8$ in.
2000 ft, $\Delta_L = 15.6$ in.
5280 ft, $\Delta_L = 34.2$ in.
10 miles, $\Delta_L = 28.5$ ft

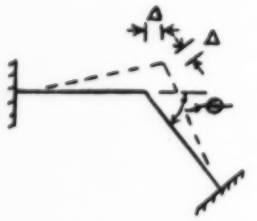
3. Since actual pipeline does not have an amount approaching these elongations, pipeline may be considered restrained.

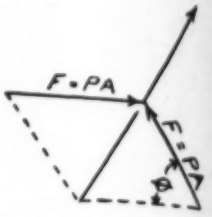
If completely restrained by anchors,



displacement, Δ_L, cannot take place, entire force, F, is transferred to reactions, and *there is no longitudinal stress due to internal pressure.*

4. For pipe with an angle Θ, unrestrained except at ends,





displacement, Δ, occurs in directions shown, and longitudinal forces and stress of (1) above applies.

The resultant $R = 2PA \text{ Sine } \frac{\Theta}{2}$

$$R = 2 \times 565{,}000 \text{ Sine } \frac{\Theta}{2} = 1{,}131{,}200 \text{ Sine } \frac{\theta}{2}$$

For Θ = 22½ deg., R = 240,000 lb
45 deg., R = 434,000 lb
90 deg., R = 800,000 lb
Due to internal pressure only.

This large resultant force R causes pipeline to move in direction shown, which if unrestrained will be resisted only by tensile stress of pipeline.

To prevent movement and stress, an equal and opposite anchor force must be supplied.

TEMPERATURE EFFECTS

5. Assume open-end pipe (no internal pressure) subject to temperature change.

If heat is applied, pipe elongates from A to B at rate of 6.5 × 10^{-6} in./in./° F rise.

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slope at the 6000-ft point may have provided the amount of restraint needed, thus limiting the movement to the easterly section. It is possible also that the coating material had not been heated to the softening temperature beyond this point and that the pipe was restrained by the normal friction between the coating and the earth.

Signs of movement

Meanwhile, the men on regular pipeline patrol began to notice signs of pipe movement along the original line in the sections downstream from each booster station. The single 30-in. line, after leaving the Desert Center station, runs west in practically a level straight-line for a distance of 2.6 miles before it crosses under the highway on a 40° angle in a 36-in. diameter casing. The ground surface over the two 40° welding elbows at each end of this crossing showed considerable cracking and disturbance, and when excavated, it was found that there had been sufficient movement to the west on the south leg from the station to split the pipe coating from the pressure against the earth. This off-set had acted as an expansion loop throwing stresses into the pipe and the two 40° welding ells. The length of this off-set is 335 ft, and the casing is approximately 90 ft long, which provided for free movement of the pipe in the center section of the off-set.

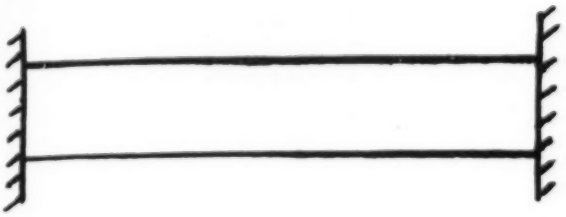
Take-off line

Approximately 5.5 miles west from this crossing is an important 8-in. take-off line serving the entire Imperial valley. This take-off is at a sectionalizing valve with two blowdown valves located in an open-top manhole. The line from the highway crossing to this take-off is in a level straight-run and no movement was detected at this vault nor west of this point to the Cactus City booster station.

If unrestrained and elongation occurs, *no stress is present in pipe wall due to temperature change.*

For a 50° F rise, elongation would be 32.5×10^{-5} in./in.
Total elongation Δ_L = unit elongation × length
For 100 ft, Δ_L = 0.39 in.
1000 ft, Δ_L = 3.9 in.
5280 ft, Δ_L = 17.1 in.

6. If pipe is fully restrained and heated,



displacement, Δ_L, cannot take place and longitudinal compressive stress, S, appears in pipe wall.

$S = 6.5 \times 10^{-6}$ Modulus of elasticity × temperature rise
$S = 6.5 \times 10^{-6} \times 30 \times 10^{6} \times T = 195T$

This stress results in a force, F, required to resist expansion

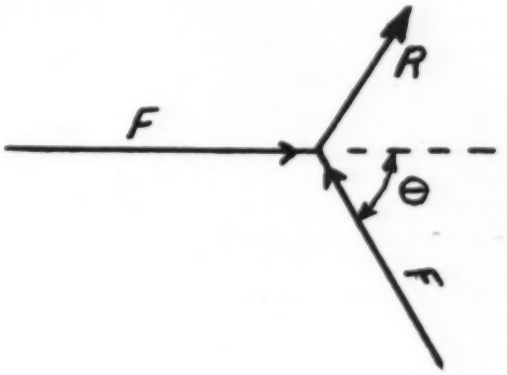
F = metal area × stress
$F = 29.1 \times 195 \times T$
$F = 5670 \times T$

For various temperature rises, the stress and forces are as follows:

Temp. Rise, ° F T	Stress, S	Force, F
10	1950 psi	56,700 lb
20	3900	113,400
50	9750	283,500

For straight pipe, anchor forces required to resist movement due to temperature changes are tabulated above. These values are independent of length or total movement being restrained. Since actual pipeline does not move any amount approaching elongations due to temperature, pipeline may be considered restrained, as in (2) above, but if restrained, *the above stresses appear as compression in pipe column.* The effect of restraint, therefore, acts opposite with respect to pressure, where it eliminates tensile stress, than with temperature, where it produces compressive stress.

7. For pipe bends, resultant force R, due to temperature, may be developed similar to (4) above,



where $R = 2F \text{ Sine } \frac{\Theta}{2}$

For a 50° F rise, F = 283,500 lb from (6) above and resultant force R for various angles is:

$$R = 567{,}000 \times \text{Sine } \frac{\Theta}{2}$$

For Θ = 22½ deg, R = 120,000 lb
45 deg, 217,500 lb
90 deg, 402,000 lb
Due to temperature alone

To prevent movement, an equal and opposite anchor force must be supplied.

COMBINED EFFECTS

8. These forces, due to pressure and temperature, are additive, hence, resultant anchor force for immobility of the bend is the sum of the individual forces tabulated under (4) and (7) above.

For angle of bend Θ, total anchor force R required:

For Θ = 22½ deg, R = 360,000 lb
45 deg, 651,000 lb
90 deg, 1,202,000 lb
Due to both pressure and temperature.

Straight line anchors are, therefore, designed for temperature effect only. Anchors at bends are designed for both pressure and temperature effects.

The 30-in. line leaving the Cactus City station has many off-sets, both horizontal and vertical, with some open spans. Evidence of pipeline movement was noted at 14 locations between Cactus City and the loop tie-in. These locations were where the pipeline changed direction either vertically or horizontally by means of ell segments or wrinkle bends, and the surface indications varied from hairline cracks (above the angle points) to one location where the pipe had raised 5 to 6 in. at the end of a span, leaving a void between the pipe and the original trench bottom. The pipe coating at the open spans had been peeled back in each location where the pipe enters the ground to the west. The pipe coating at the angle-point fittings had been damaged from the sliding contact with the earth in a similar manner as noted on the highway crossing west of the Desert Center station.

It was significant that no signs of movement were noted at the valve vaults since the blowdown piping connections in the vaults would have been subjected to severe bending stress if movement in the vaults had occurred. The failure of any of these blowdown connections did not appear to be eminent, but we realized the possibility of such a failure due to high stress concentrations and we faced a difficult problem in either restraining the pipe movement or designing expansion loops to allow for the movement.

Pipe coating

The first observations of the condition of the pipe coating in the areas of movement revealed what appeared to be extensive damage to the outer wrapper and it seemed probable that we had 20 or 30 miles of pipe that would have to be reconditioned. Tests, however, have indicated that, in general, the coating is still effective, and we have not had to apply any special protection to this section of the line with the excep-

Expansion problems . . . Extensive efforts were made to find all wrinkle bends

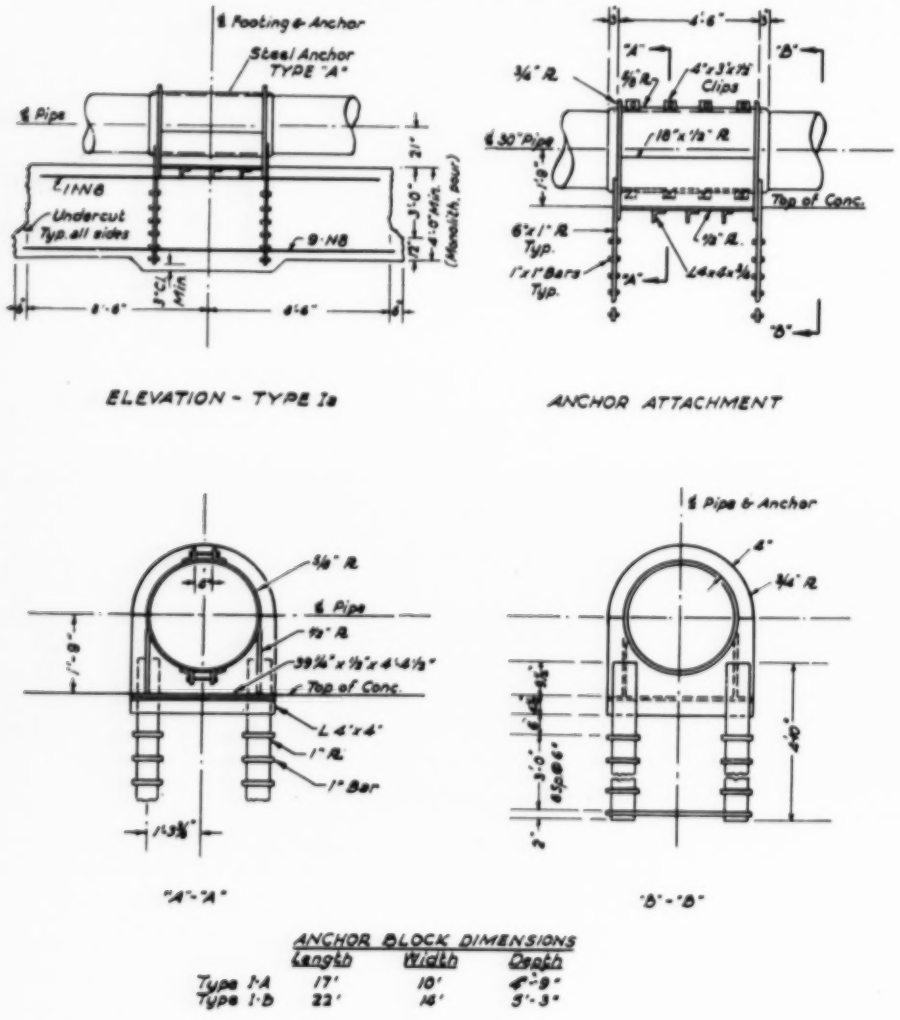


Fig. 7. Anchor for 30-in. pipeline.

tion of repairing the coating at the angle points and exposed spans where damage was severe. *Fig. 5* is a photograph of a short section of exposed pipe showing the type of damage resulting where part of the coating was restrained by the earth and part of it was free to move with the pipe.

The pipe, for both lines, was yard-coated with a single coating consisting of a primer, a layer of enamel applied with an average thickness of 3/32 in., and one wrap of 15-lb asbestos-felt wrapper. The physical characteristics of the enamel on the two lines are not the same, but since the conditions in the sections where slipping occurred were different for the two lines, no evaluation can be made as to which coating had the more resistance to movement. The coating on both lines undoubtedly is damaged, but it may be several years before the extent of the damage is known.

Was the pipeline structurally reliable?

After the failure of the blowdown tap, time elapsed while we continued our observations as discussed in the first part of this article. By the time we were aware of the extent of the pipe movement, the hottest part of the summer was past and the immediate crisis was over. With ground temperatures decreasing, there was less concern about the possibility of other failure during the coming winter months, and since plans were in progress to install an additional 73 miles of parallel 30-in. line easterly from the 14-mile section, part of which would be in the hot zone west of Cactus City, the solution of the expansion problem was postponed until the new construction was completed.

In addition to this problem, we had experienced a failure of a wrinkle bend near the town of Moreno, in January 1949, less than two years after the line was placed in operation. It was demonstrated that this failure resulted from the wrinkle bend being made across the longitudinal weld of the pipe and was due to the lack of ductility of the weld metal. Immediately, extensive efforts were made to locate all such wrinkle bends and reinforce them with enclosing bands, and the subsequent satisfactory service of the line would indicate we were successful.

New possibility

However, with the new problem of thermal expansion adding the possibility of other blowdown or off-take failures, and increasing the possibility of other wrinkle bend failures, there was a growing anxiety about the structural reliability of the entire 30-in. line. When it is realized that the company depends on this line for over 50% of its regular, daily gas supply, one can appreciate the concern about the possibility of having a serious line break. We were in need of expert advice, so we presented our problem to Stone & Webster Engineering Corp. for its study and recommendations.

Ours was a unique problem of a major pipeline having hot zones in which the pipe could slide inside the wrapper, thus losing the benefit of ground restraint normally experienced in a pipeline, and this condition of movement causing excess stresses in the pipe at cross connections and abrupt bends.

Normally when thinking of providing for expansion or contraction in a pipeline, one is led to expansion loops because this has been the standard practice in treating high temperature pipelines for years. It was natural, therefore, that Stone & Webster, and ourselves, first considered, in a preliminary study, the use of expansion loops at the cross connections with sufficient anchors at the critical off-sets to force the movement of the line into the loops. An isometric drawing of a preliminary design showing the use of expansion loops at a typical mainline valve and blowdown connection is shown in *Fig.* Note that the design allowed for a relative movement between the two 30-in.

lines, as well as movement between the mainlines and the anchored blowdown-stacks. Although the two 30-in. lines would not necessarily be expected to have a corresponding movement, even if installed at the same time, unequal movements were anticipated in these two lines, particularly since the original line was laid in the summer and the parallel line was laid in the winter months. After the 73 miles of parallel line had been installed and placed in service, there were indications of movement in the hot zone west of Cactus City station of the same nature, and at similar locations, as has been described along the original line. It appeared that the parallel line was moving about the same as the original line but, of course, this nearly equal movement could not be depended upon for designing the expansion loops.

Not ideal solution

After further study, it was decided that although expansion loops could be designed to allow for any assumed amount of movement resulting from these temperature changes, the use of expansion loops did not appear to be the ideal solution to our problem. The loops had to be large to allow for any predictable amount of movement and, if installed above ground, they constituted an attractive target for desert marksmen, they would be an attraction for sabotage, and they would require excessive fencing according to our policy of protecting all such installations. This fencing would increase the cost and limit the accessibility to the mainline valves in the event of major repairs. If the loops were installed below ground, in the necessary casings to provide freedom of movement, the cost would be nearly prohibitive. Also, there were a few locations where additional right-of-way could not be acquired to accommodate the piping.

After a review of the field conditions and a number of conferences between ourselves and Stone & Webster's engineers, it was agreed that the latter should consider the use of anchor blocks to restrain all major pipeline movement as a substitute for expansion loops, and that we would accept the use of anchor blocks if Stone & Webster recommended them, but were concerned about the effect of this type of restraint on the cold wrinkles in the original line.

After a thorough study of the use of anchor blocks, Stone & Webster submitted a report on their observations and recommendations, which, in general, were as follows:

1. That a continuous, straight pipeline laid underground in a reasonably level terrain is self-restrained and has little movement even when subjected to considerable temperature change and the coating is softened by the high temperatures. The major movement occurs in hilly terrain where vertical and horizontal bends and open spans of pipe exist that prevent suitable self-restraint.

   Protection of the 30-in. lines, therefore, can be limited to that section between Desert Center station and valves 8-8A, with special attention to the portion between Cactus City station and valves 8-8A.

2. The increases in length due to internal pressure and to thermal expansion are of a progressive nature and would be difficult to predict. In addition to the objection previously mentioned, expansion loops might be only a temporary remedy for this condition and rigid anchors appear to offer a more satisfactory solution.

   The type of restraint offered by anchor blocks should not create stresses in the wrinkle bends materially different than those created by the normal restraint. The one wrinkle bend that failed apparently failed in tension and the forces introduced by the higher gas temperatures will produce compression in the pipe; however, as a precautionary measure, the wrinkle bends within 1300 ft of either side of the anchor should be reinforced with a protective sleeve. (After a further study of field conditions this distance was reduced to an average of approximately 500 ft.)

3. That supports be provided at each exposed span in the distance between Desert Center booster station and valve 8-8A to limit the total span to 75 ft. This is necessary to make the exposed pipe act as a column when in compression. (The maximum unsupported span was 130 ft on the original line and 100 ft on the parallel line.)

4. That further stress analysis to evaluate the probability of failures would be time consuming and costly. The selection of locations for the proposed anchors where evidence of trouble existed or might be anticipated, and the application of corrective measures, offers the only economically sound solution to the movement problem. The possible need for additional structural modifications should be determined by establishing a number of observation points where future pipe movement can be measured.

Designing the anchors

The design of the anchors depended upon the forces involved, the soil conditions, the method of attachment to the pipeline, the suitability of materials, and the cost. An analysis of the forces acting on a pipeline is rather elementary, but is interesting and will serve to show the basis of determining the anchorages required. Many gas industry people may never have had reason to determine the magnitude of these forces due to temperature change and internal pressure, so the calculations on pages 114 and 115 have been included to give a better understanding of the problem.

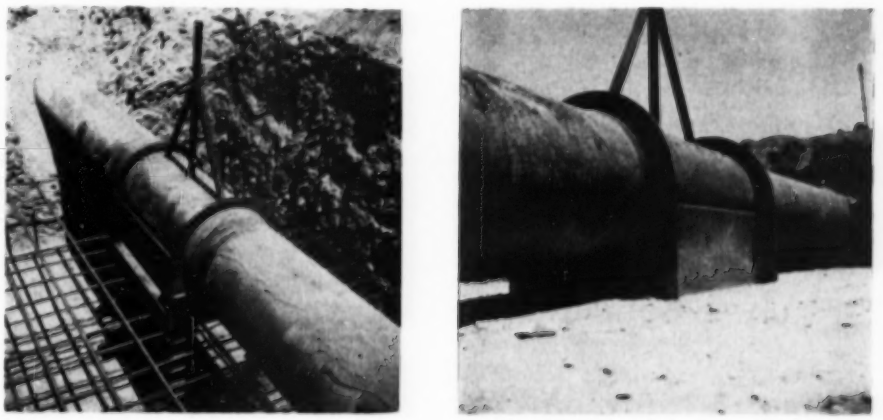


Fig. 8. Views of Type I-B anchor. At left is view from top and at right is the completed anchor.

Selecting the final designs

Originally, three types of anchor blocks were considered; one for a straight-line location, one for vertical angles, and one horizontal angles. Each type had an alternate design whereby the resistance clamp welded to the pipe could be either totally embedded in the concrete block or exposed and secured to the concrete block by structural attachments. The alternate designs with the pipe embedded in the blocks were eventually discarded since we wished to avoid elaborate corrosion protection

Expansion problems . . . Efforts were made to reduce cost by simplification of design

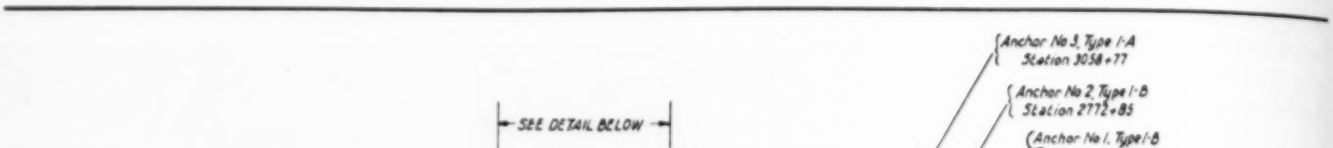
seals between the concrete and pipe, especially where the pipe enters and leaves the concrete block. Also, it was desirable to allow for complete access to the pipe, and by lowering the blocks below the pipe it was possible to obtain higher soil-bearing pressures at the greater depths and reduce the amount of concrete required. Every effort was made to reduce the cost of installation by simplification of design. Straight, rectangular shapes were used to allow for pouring against undisturbed soil in *Fig. 8.* The reinforcing steel placed perpendicular to the center line of the pipeline, as shown in the photographs, was not included in the design of the Type I-A anchor. The pipe welded to the top of the anchor is a reference marker for observation purposes after the anchor was backfilled.

The method of attaching the anchor to the pipe posed a problem since the pipe material is cold worked to obtain its high yield strength, and welding directly on the pipe would anneal the steel plate and reduce the yield strength. The pipeline was designed with an allowable hoop stress of 35,000 psi in the desert section, which is about the maximum for pipe with a 52,000 psi minimum yield; therefore, a longitudinal weld on the pipe was not advisable. Since the lowest stress in the pipe wall is in the direction parallel to the centerline, the use of long circumferential saddles was advocated with all welding to the pipe in a plane perpendicular to its centerline.

Thrust transmitted

The pipe thrust was thus transmitted from the pipeline to the saddle by the circumferential welds at both ends of the saddle, and from the saddle to the concrete block by the circumferential end plates and the two longitudinal stiffening plates. The saddles were keyed to the concrete by angles to take shear, and the long straps and bars provided at each end were designed to resist overturning due to the eccentricity of the applied load. In a preliminary design, the concrete was to be poured level to the bottom of the pipe but a clearance of 6 in. was provided in the final design to permit easy inspection of the pipe and to allow for working space in case it should become necessary to free the pipe from the anchor for replacement of the pipe due to other causes.

Concrete was chosen for anchor blocks rather than batter piles because



DETAIL

Fig. 9. Diagrammatic sketch showing anchor numbers, locations, and types as installed.

without forms, thus giving maximum, undisturbed earth-restraint. At changes in direction, where large massive blocks were originally considered, alternate methods of anchorage were developed in which straight-line type anchors were designed for both pressure and temperature restraints to be located on the straight section of pipeline close to the bend. Thus, only two designs were finally used and they differed only in the dimensions of the anchor block and the amount of reinforcing steel required. The Type I-A anchor, shown in *Fig. 7,* was designed to restrain temperature force only. The Type I-B anchor was designed to restrain both pressure and temperature forces. Several photographs of a Type I-B anchor are shown

of its availability in the remote areas required, its resistance to corrosion, the desired mass and friction inherent in this type of structure, and the relative simplicity and low cost of installation. Anchor thrust considered was the passive pressure on the ends of the concrete block, plus the frictional resistance against sliding on the bottom.

Installing the anchors

The installation of the anchors was not a difficult job but there were a number of problems involving planning and the scheduling of the work, with the inevitable deadline to meet. It was the middle of May before everyone had agreed upon the use of anchors, and the designs had been completed, so with

desert temperatures rising every day, it became an urgent matter to get the anchors installed. It was planned to anchor the lines while the pipe temperatures were midway between the extremes of summer and winter operations to minimize the stresses that would be induced in the pipe by these temperature extremes. In conjunction with the anchors, 73 wrinkle bends were to be reinforced and a miscellaneous number of A-frames installed.

The general locations for each anchor was shown in the Stone & Webster design, but the exact location had to be determined in the field based on the following considerations:

1. Anchors must be located so as to have undisturbed soil for a minimum distance of 60 ft either side of anchor centerline (not near an open span).

2. Depth from ground surface to bottom of anchor block must not be less than 9 ft-6 in. for Type I-A and 11 ft-0 in. for Type I-B. With less cover, the size of the anchor block would be increased.

3. Steel anchor attachment must not be made at a wrinkle bend.

The final locations are as shown in *Fig. 9.* At the road crossing west of Desert Center a Type I-B anchor was installed about 100 ft east of the south ell, and 100 ft west of the north ell. At valve No. 5, where the Imperial valley tap is located, even though no movement had been detected at this location, the installation of a Type I-A anchor was recommended as a precautionary measure to safeguard this important take-off.

Precautions

At the discharge of Cactus City station a Type I-A anchor was installed on each line as a precautionary measure due to the high temperatures in this section of the line. At the vertical rise east of the highway crossing, west of the Cactus City station, it was intended to install a special anchor designed for the vertical angles. On the original line, the soil at the angle point was very sandy, and the angle point on the parallel line was near a small wash, so the anchors were located about 280 ft east of the angle points and Type I-B anchors were used. Between the upper vertical angles and the south angle point at the highway crossing, the distance was about 1000 ft. One anchor on each line, about half way, was considered adequate for both angle points.

Since no excessive movement had occurred at the north turn of the highway crossing, no anchor was included at this location, but special attention was given to the compaction of the backfill at both the north and south angle points of the highway crossing. At the 26° horizontal bend, about 7000 ft west of the highway crossing, movement to the west had occurred in the original line so anchors were located just east of these angle points and west of the 15° horizontal angles to protect this off-set from both directions. The 721 ft of concrete-encased, heavy-wall pipe in the bottom of Thermal Wash served as an effective anchor to the west. Since no significant movement of the original line had occurred at valve No. 8 or west of this valve, no anchors were considered necessary on either line west of this point.

Expansion problems . . . A check is made for longitudinal movement at the anchor blocks

Procedure

The general procedure followed for installing the anchors was as follows:

1. Make a preliminary excavation for installing the sleeve, and clean the pipe.

2. Clamp on sleeve and complete longitudinal weld. Remove bolts and clips.

3. Make final excavation for anchor block.

4. Install box assemblies and complete welding. (By scheduling the time for the circumferential welds on the pipe, pressure cutbacks were held to a minimum. For pipe designed for 807 psig working pressure, the pressure for welding is 565 psig and for a 725 psig design the welding pressure is 510 psig.)

5. Install reinforcing steel in block.

6. Install bench mark and riser on anchor sleeve for reference.

7. Pour concrete.

8. Coat and wrap pipe and sleeve.

9. Backfill, clean-up, and install markers for gauging possible future longitudinal movement.

The concrete was mixed at the site and one large or two small blocks were poured per day. A spare mixer was maintained on standby since the blocks were to be a monolithic pour and a mixer breakdown could cause more trouble than the standby mixer cost. The pouring was scheduled so that the anchors on each line could be poured as a group, and the line pressure and temperature controlled as recommended. The Stone & Webster recommendations were as follows:

> For 36 hr before, and 48 hr following pouring of concrete, line temperature at anchor location should be maintained as near 95° F as possible. Pressure to be maintained within ± 10 psig for first 10 hr after pouring, and ± 25 psig of a constant for a minimum of 36 hr. Line pressure not to exceed 550 psig for 48 hr following the installation.

Construction was started about the first of June, and nearly all the welding and concrete work was completed by the first week in July. The entire job, including the installation of the wrinkle bend reinforcements, was finished by the end of July. The total cost of the project amounted to $98,614 with the following breakdown:

Anchor blocks		$60,436
Type I-A, average	$3984	
Type I-B, average	$5753	
Banding wrinkle bends		$23,775
Average per band	$325	
Installation of A-frames		$14,403
Total		$98,614

Conclusion

Before each anchor block was poured, elevations of the pipe riser and bench mark were taken. After the block was poured, and at intervals since then, elevations have been taken to determine if the anchor blocks have settled or otherwise moved. No such movement has taken place. In addition, a regular check is made for longitudinal movement at the anchor blocks and at each valve location. No longitudinal movement has been noted.

We now have gone through a cycle of summer and winter temperatures without trouble since the anchors were installed. During the past summer we did not experience the maximum temperatures we can expect since either one or the other turbine stations was out of service most of the summer, but the indications are that the method of anchoring, the design of the anchor blocks and clamping attachments, and location of the anchors, as recommended and designed by Stone & Webster, have been entirely satisfactory. ■

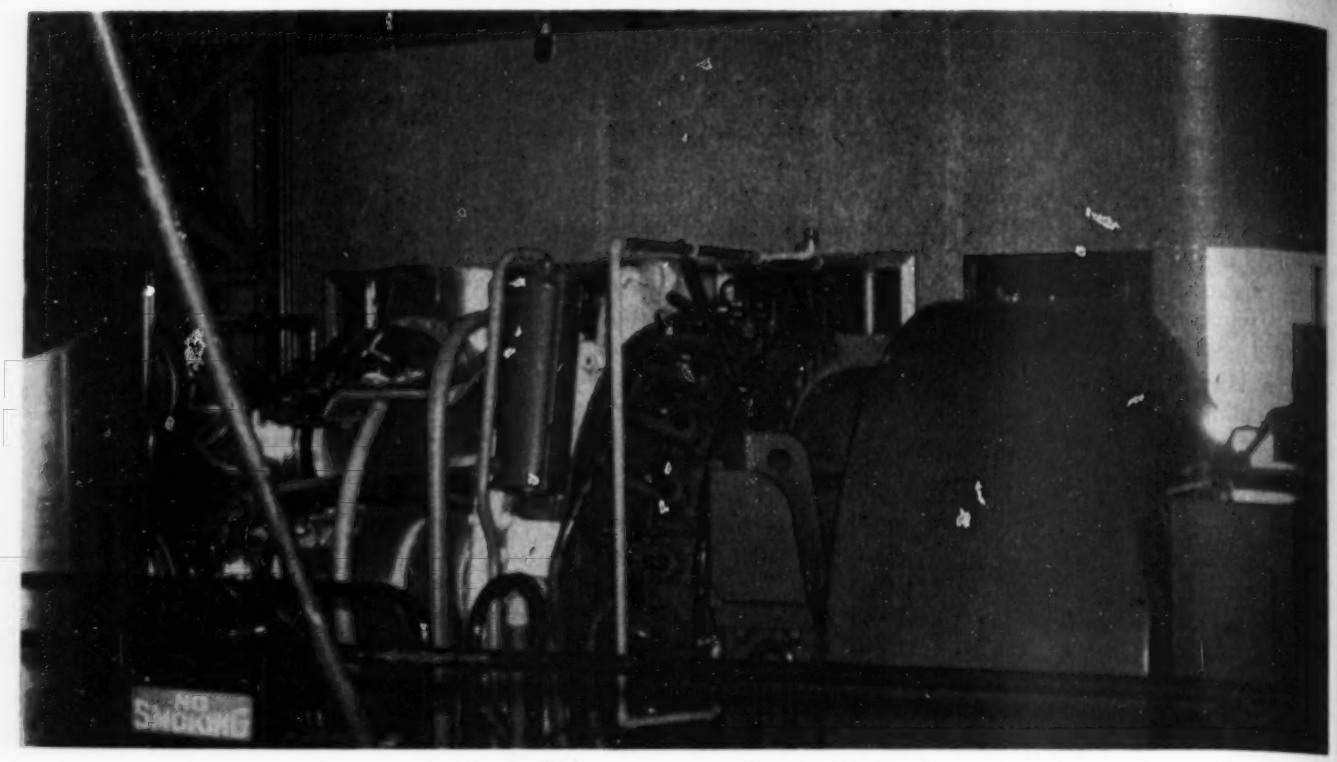


Fig. 1. Gas turbine showing spray piping around hot surfaces.

Fire protection for isolated gas turbine stations

By E. E. TAYLOR • Southern California Gas Co.
and
L. J. FAST • Southern Counties Gas Co. of California

IN industry generally, the need for specialized fire protection facilities in operating plants frequently is overlooked or not well understood. The general feeling seems to be that a few hose lines and a few portable first aid fire extinguishers are all the fire control facilities necessary regardless of the particular hazards involved. The idea seems to be that if a fire occurs, you put it out with an extinguisher if you can, or you call the public fire department and rely on it to extinguish the fire and save the property. Also, there seems to be a general idea that steel buildings, such as those used in many different operations, are "fireproof" and therefore cannot burn.

The gas-turbine driven, centrifugal compressor stations owned jointly by the Southern California Gas Co. and Southern Counties Gas Co. are situated on the 30-in. pipeline system transporting gas from west Texas and New Mexico to California. Gas is delivered by El Paso Natural Gas Co. near Blythe, on the Arizona-California border. At Blythe, the gas is compressed in a conventional reciprocating-engine station of 25,280-hp from 500 to 800 psig. About 45 miles west of Blythe is our Desert Center booster station, and approximately 31 miles west of Desert Center is our Cactus City booster station. At each of these stations we have a 5700-hp General Electric gas turbine, driving a DeLaval centrifugal compressor.

At the outset of the study as to what and how much fire protection would be required for our gas-turbine driven compressor stations, first consideration was given to the peculiarities of the location of each station. Both the Cactus City station and the Desert Center station are located at such distance from each other, and from any other source of help, as to practically eliminate the possibility of obtaining outside help in case of fire. Because of their desert locations, the lack of water in desirable quantities made it necessary to plan for the most conservative use of available water and to consider some other fire control medium to supplement or replace water.

Consideration also was given to the fact that under normal operating conditions, only one man is on duty at each station. Whatever might be the requirements of an emergency, everything would have to be handled by this one operator. He would have to make whatever operating adjustments were

This article has been adapted from a talk presented at the PCGA transmission conference held May 2-3 in Palm Springs, Calif.

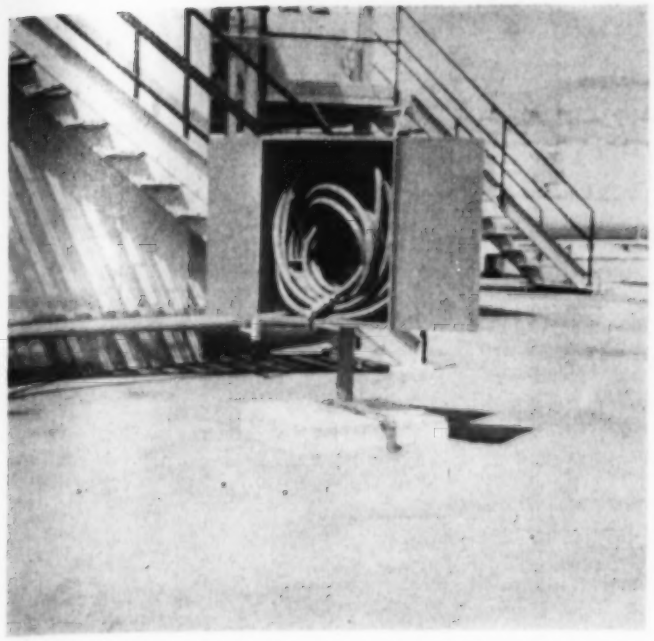


Fig. 2. Typical one-man fire hose units.

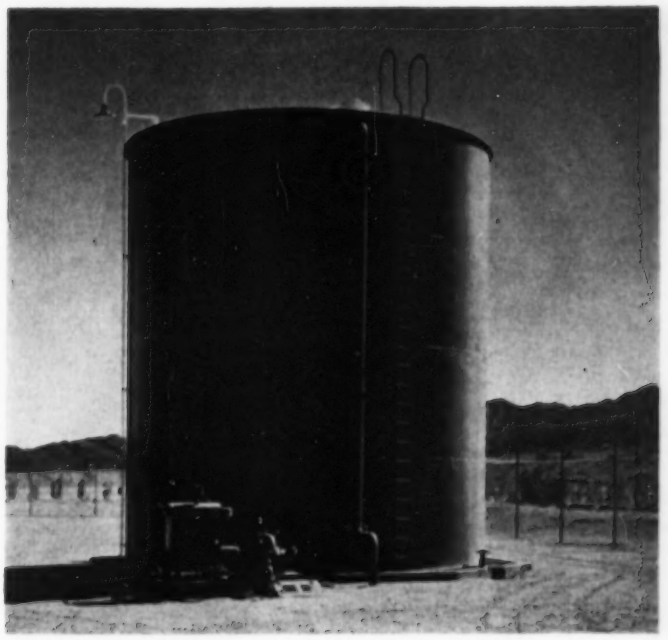


Fig. 3. Water storage tank with old fire pump in foreground.

required, closing or opening valves as necessary, notifying Blythe as to what was taking place, and in addition, actuate fire fighting facilities to combat the fire. When consideration was given to the possibility that this lone employee might be incapacitated by whatever happened, it became obvious that a certain amount of automatic shutdown facilities as well as automatic fire control facilities would be essential to the performance of the many necessary operations called for by an emergency.

In designing the general layout of the plant, consideration was given to the need for providing a reasonable amount of separation of facilities. The main transmission line, the main control valves, bypass and metering facilities are all located some little distance from the main compressor building. No

Separation of facilities

actual transmission gas lines enter the main part of the building, the main gas compressor being located outside the building. The main turbine and accessory engines, the shop, and the control panel, and other such facilities are located inside the main building.

The auxiliary engine room is located on the ground floor and contains a gas-engine driven air compressor and a gas-engine driven auxiliary, electric generator set. Also on the ground floor is a work shop area where small repairs are carried out, including welding. The main turbine and the main gas compressor are located on an upper level, which is constructed as an open mezzanine floor (see *Fig. 1*). The office and control panels are located on this floor adjacent to the main turbine with a glass wall for separation. The cooling water pumps and fans are located adjacent to the outside of the main building. The main turbine combustion air heat exchanger is located immediately outside one wall of the main building. The combustion air ducts to the turbine enter the building through a closed-off area or basement section of the ground floor, immediately under the main turbine.

Lubricating oil is brought to the station in 50-gal. drums. It is pumped from these drums into tanks located in the compressor building. The oil transfer operation and the oil storage inside the building, therefore, constitute a potential fire hazard.

Probably the most serious potential fire hazard has to do with the lubrication oil for the bearings of the main turbine. Should a break occur in one of these pressured oil lines, oil probably would spray over a large part of the interior of the building. If it contacts a sufficiently hot surface, it would immediately be ignited and the whole area might be enveloped by flame fed by oil under pressure. During our consideration of this aspect of the problem, we determined that the average flash point of ordinary lubricating oil was about 535° F and the ignition point above 783° F. Some lubricating oil used for turbines has a flash point of only 400° F and an ignition point of only 700° F. In this connection it should be realized that there are certain exposed surfaces on the turbine that may reach a temperature of 1450° F. These facts, when put together, assure a potentially disastrous fire unless adequate control facilities are provided.

Small lines considered

Another point deserving serious consideration was the small lines leading to gauges, meters, etc., in the control room. Many of these lines are "live" lines carrying gas under various pressures up to 700 psig. A break in one of these small lines, if ignited, would produce a torch flame of such intensity that it could melt through larger piping, etc. in a very short time.

Even the aluminum sheet covering, used to enclose the insulation on some of the air inlet and exhaust piping to the turbine, could be a contributory source of fuel, since it would burn when subjected to intense heat. During the first test operation of the plant, the original insulating material on the air ducts caught fire. All of this material has been replaced with other insulation, which is expected to stand up under the high temperatures involved.

Another small fire developed at one of the plants during the final construction period when hot slag from a welding operation lodged in boxed and

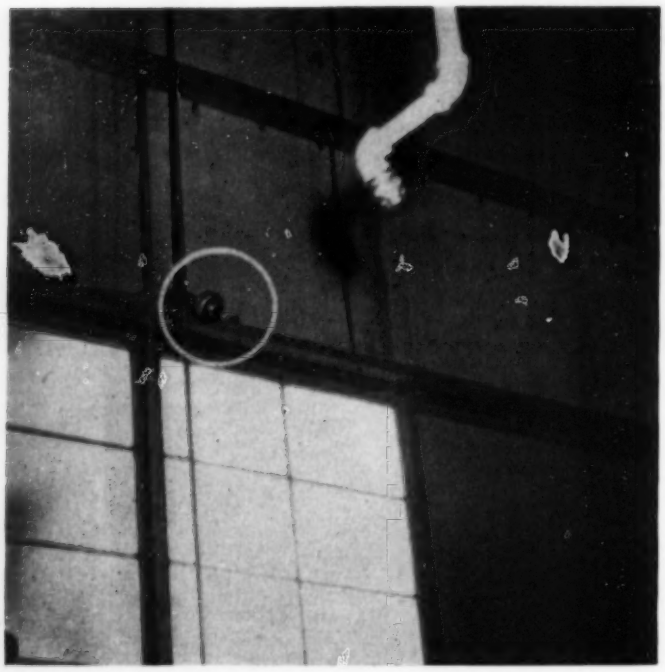


Fig. 4. Typical fire detector cell.

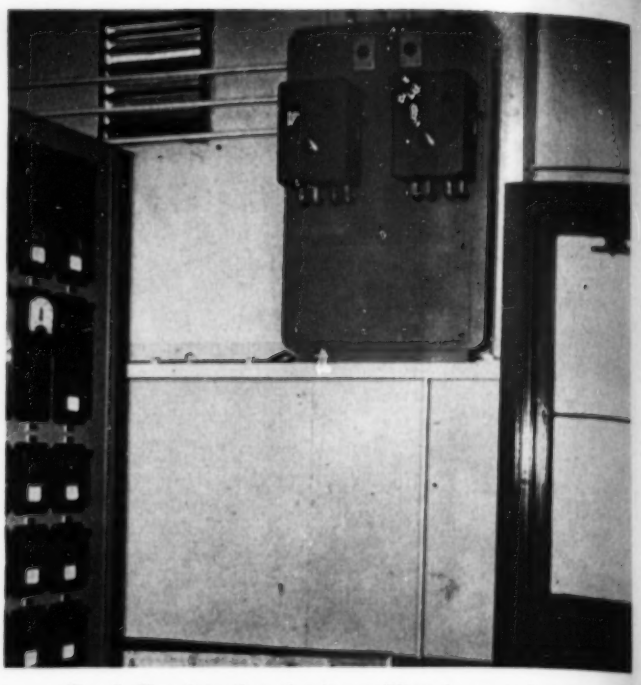


Fig. 5. Fire detection circuit amplifiers in control room.

crated material in the shop area. Ironically, the crates and boxes contained fire hose and other fire protection supplies, which, of course, were damaged by the fire.

Mechanical failure

Several months after the plants were first put in regular operation, a mechanical failure in the gear box driving the oil pump, generator, etc., on one of the turbines, caused lubricating oil to be sprayed into the engine room and duct room. This oil was ignited upon contact with hot surfaces. The fire that resulted impressively demonstrated what might be expected on a much more serious scale in the event of failure of a high-pressure-seal oil line or a high-pressure, small gauge line, etc.

Primary fire extinguishing facilities, of course, were installed early in the construction period as would be the case for any operating property. Portable hand extinguishers, largely foam and dry-chemical, were placed at proper intervals. Also, a fire line system was provided which made use of "oneman" fire hose units with fog nozzles (1-in. hose)

Fig. 6. Expansion turbine-driven centrifugal fire pump and actuating controls.

(*Fig. 2*). A gas-engine driven fire pump was installed to boost pressures from the gravity water-storage tank to about 150-psig pressure in the fire lines (*Fig. 3*). With these facilities, it should be possible to control ordinary fire situations, but as has been pointed out, a study of the fire potentialities of the station indicated the need for a more elaborate, permanently installed, and automatically actuated system.

Fire system

The system installed at each turbine station is a completely automatic fire-detection and control system. The heart of each system is the equipment furnished by the Fireye Division of Electronics Corp. of America, consisting of sensitive detectors and amplifiers.

The entire sequence of events for controlling a fire and sounding alarms at each station is placed in operation by seven strategically located detectors.

The fire system at each station is divided into two areas:

1. Detection and control of fires in the turbine room.
2. Detection and control of fires in the compressor and duct room areas.

This area division was made to minimize the possibility of water damage in areas where there is no fire.

Sequence of events

Let's follow through a typical sequence of events in case we had a fire in the duct room area underneath the turbine:

Fire protection . . . Detectors distinguish flame from constant radiation

Just a few seconds after the flames start, the Fireye system detects the flame and through a system of relays starts the following chain of events:

1. Trips the plant emergency shutdown system, shutting down the turbine and blowing down the station piping.
2. Starts the emergency fire pump.
3. Sounds an alarm horn.
4. Transmits a radio alarm to Blythe and Indio.
5. Turns off the foundation ventilation fan.

Time delay

Sixty seconds after a fire is detected, water is sprayed from the fog heads in the duct room and compressor areas only. This time delay will allow the station operator to make an attempt to extinguish the fire. If the operator can extinguish the flames within the delay period, no water will be sprayed; if he is unable to extinguish the flames, a solenoid-controlled master valve opens on the water system and water is sprayed through the nozzles. At the end of a 3-minute period, a timing device closes the water valve and the water pump will shut down unless the detectors are still "seeing" flame, in which case the attempted shutdown of water is overridden.

Now let's look back over the sequence of events and fill in a few of the details:

Electronic equipment

The heart of the Fireye system is a miniature, rugged, photo-conductive cell developed by the Fireye engineers specifically for the purpose of fire detection (*Fig. 4*). The detectors indicate, by very rapid resistance changes, the varying amounts of infrared radiation emitted by a flame. They detect the flicker that distinguishes flame from a constant radiation. The varying radiation from the flame results in a pulsating signal being sent from the detectors to the amplifiers, which, being frequency-sensitive to this signal, actuate our own system of relays. (See *Fig. 5.*) Discrimination from other radiation, such as from the sun, incandescent lamps, etc., is obtained by the rejection, within the control panel, of all pulses below approximately 6 cps and above 30 cps. In addition, discrimination against visible light is obtained by an optical filter cover over the cell which passes only infrared radiation. The detector does not have to "see" the flame directly to set off the alarm. Since most all materials readily reflect infrared radiation, the system can detect a fire either directly or by reflection as well as through glass.

Pump and spray equipment

The fire pump is a direct-connected turbine-driven centrifugal water pump unit consisting of a General Electric DP-16, Class I, 52-hp turbine driving an Ingersoll-Rand #3 DHV centrifugal pump with a 400-gpm capacity at 150 psig discharge pressure. (See *Fig. 6*). The turbine is essentially a steam turbine adapted to operate on natural gas at 150 psig and exhausting to atmosphere. The turbine is very similar to the starting turbine on the main unit.

Water supply

The fire pump suction is on a 52,500-gal. working capacity water storage tank. (See *Fig. 7*). At the maximum rate of 400 gpm, our supply is good for at least 2½ hours.

We considered the use of a "first aid" pressurized water tank of about 4500-gal. capacity; and also considered the use of a gas-engine driven pump during the design of our system. It was decided, however, that the expansion turbine-driven pump would be dependable on instant starts and that this dependability would eliminate the need of a first aid supply.

Two 4-in. solenoid-operated valves control the flow of water to the fog piping systems (*Fig. 8*).

Water cooling

In our design of the water fog installation used around the turbine, it was fully recognized that damage might be done to hot portions of the equipment as a result of water cooling. However, this system differs materially from conventional protection; first, in the quantity of water discharged per head, and second, in the positioning of those heads immediately adjacent to

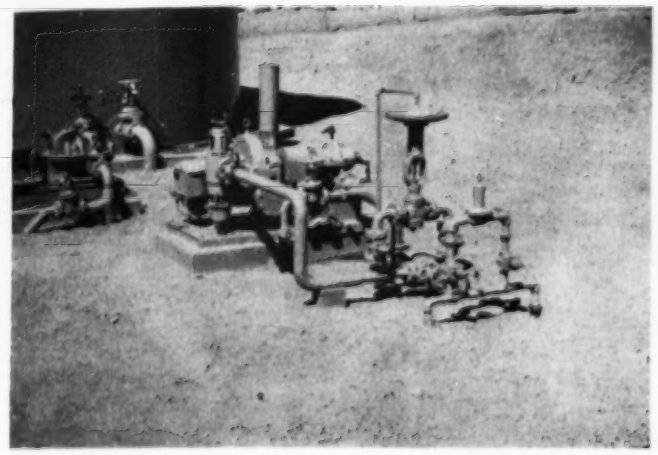


Fig. 7. Centrifugal fire pump with water storage tank and station fire pump in background.

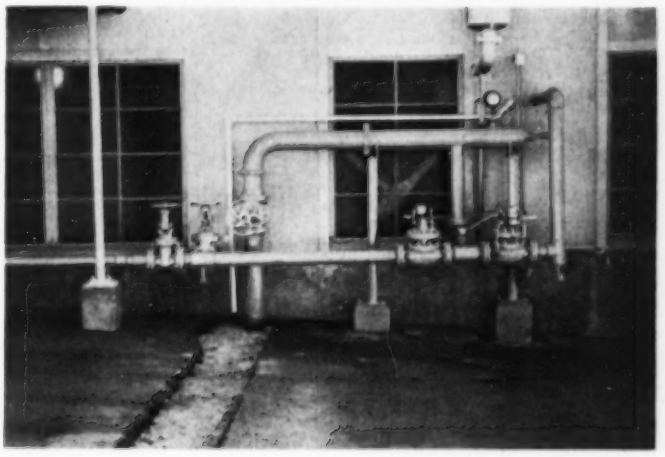


Fig. 8. Strainer and solenoid-controlled valves on water fog fire system.

Fire protection . . . Alarms are received at points where there is 24-hour attendance

the turbine. A conventional sprinkler system discharges water at the rate of 0.25 to 0.4 of a gallon per square foot, and the water drops are very large in comparison with the particles discharged by fog systems. Fog heads of 15-gpm capacity spaced at 12-ft intervals would deliver about one-third the rate of a conventional sprinkler system. The minute water drops of the fog system, and their dispersion throughout the turbine room, will essentially nullify the likelihood of damage through distortion of hot metal. The fog heads immediately adjacent to the hot machinery are positioned so as to discharge away from the hot surfaces (*Fig. 9*). The velocity of the discharged fog is such that it tends to pull flames into the spray pattern and the hot gases are so intermingled with water that the intensity of the fire is greatly or completely reduced.

Alarms

Since there is only one man normally in attendance at each station, we felt that it was advisable to design alarms into our system in case he became incapacitated and that these alarms should be received at point where there was around-the-clock attendance. Our Blythe compressor station is the nearest point fulfilling this requirement.

Secondary reception point

The Indio base was selected as a secondary reception point since the radio alarm facilities at that location terminate in the housing of the supervisors as an alarm buzzer.

The alarms are actuated by the fire detection amplifiers through our own system of relays. The radio alarms last only 30 to 60 seconds so that emergency communications as a result of a fire will not be unduly hampered. The alarm systems terminate at Blythe and Indio as flashing lights and audible alarms. The alarm signal generated at each turbine station is basically a tone signal superimposed on the radio transmission. Receivers at Blythe and Indio, sensitive to the different tone from each turbine station, actuate the alarm devices at these locations.

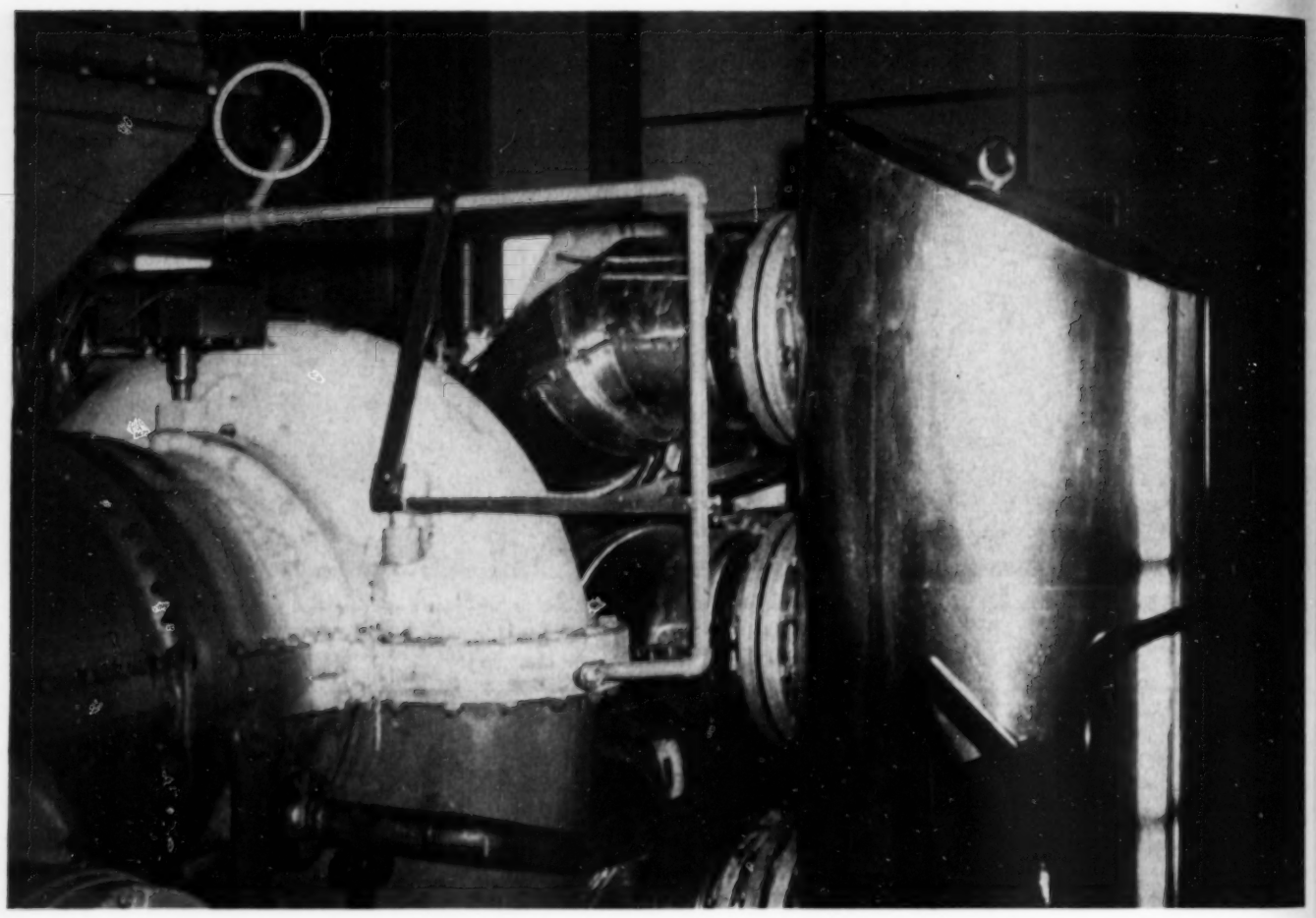


Fig. 9. View of turbine showing positioning of fog piping and nozzles near hot surfaces.

To our knowledge, these fire protection systems are the only ones of their kind located in compressr stations on a gas transmission system. The systems were designed on a consultant basis by Stanley D. Clithero of the General Petroleum Corp., who has had many years experience in fire protection for industrial plants and is considered to be one of the leading fire protection engineers in the oil and gas industry. ■

UNDERCOVER AGENTS AT WORK

Dependable protection against underground corrosion is one of the most essential considerations in the installation of any pipeline. This protection usually consists of an insulating, corrosion-inhibiting coating applied to the pipe surface, with further shielding provided by a wrapper to resist abrasion and soil stress. These are the "undercover agents" that safeguard pipeline installations against corrosion leaks and deterioration.

Throughout the nation today, leading utilities and pipeline companies look to Dearborn for long-term protection of one of their most important investments—the carrier pipe that must transmit material thousands of miles to its consumer. Dearborn's NO-OX-ID Coatings and NO-OX-IDized Wrappers provide chemical and mechanical protection against moisture penetration and soil action—protection that lasts for decades—on installations under ground or under water.

Whether applied by hand . . . by Traveliner . . . or at the mill, Dearborn Coating Combinations are your best assurance of dependable, long-life protection. On your next pipe-coating job, you'll find it pays to specify Dearborn NO-OX-ID.

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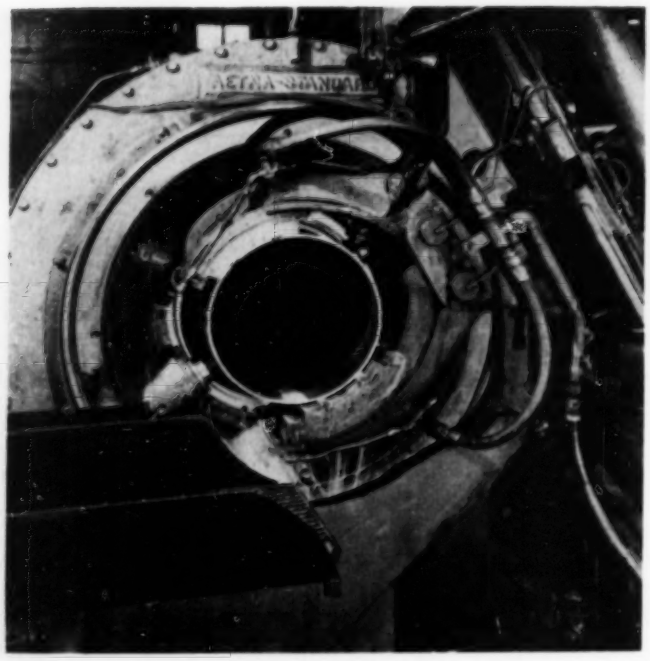


Preparation of seamless pipe for expansion begins at the two rotating cutoff machines, which were specially designed to keep pace with the rest of the producing unit. In the machine, the pipe is held by clamps while six cutting tools in the rotating head trim the pipe end. These machines trim pipe ends four to six times faster than ordinary pipe cutoff machines.

New pipe expansion equipment used at National Tube's Lorain Works

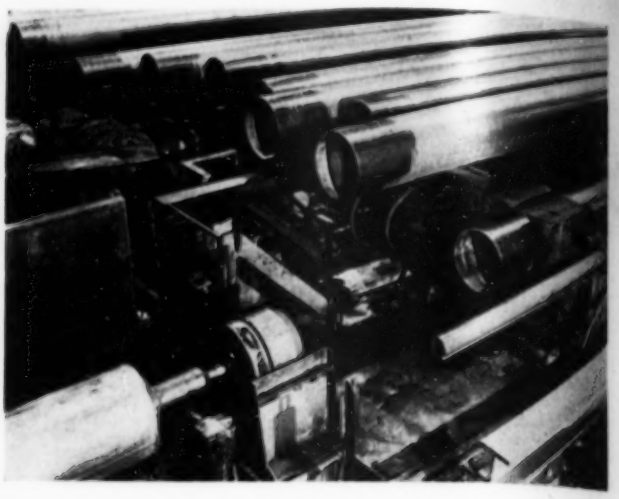
SHIPMENT of cold expanded seamless pipe is now being made from the Lorain Works of U. S. Steel Corp.'s National Tube division. The new, expanded seamless pipe combines high strength and maximum safety presently needed in the construction of a 24-in. natural gas transmission line that will extend across 250 miles of densely populated area in the eastern United States.

Operation of the new expansion unit at Lorain marks the completion of a program of continuous research and its development. The equipment is designed to expand pipe in the size range of 16- to 26-in. OD.

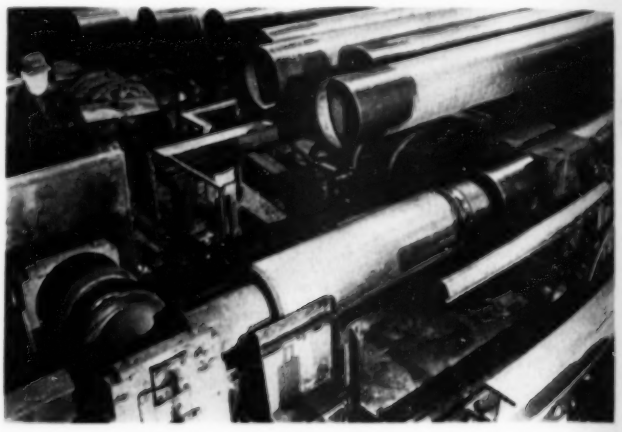
"The new process maintains the complete reliability of seamless 'walls without welds' and adds uniform high strength with excellent weldability through the use of mechanical cold work," H. J. Wallace, vice president-sales of National Tube, stated.

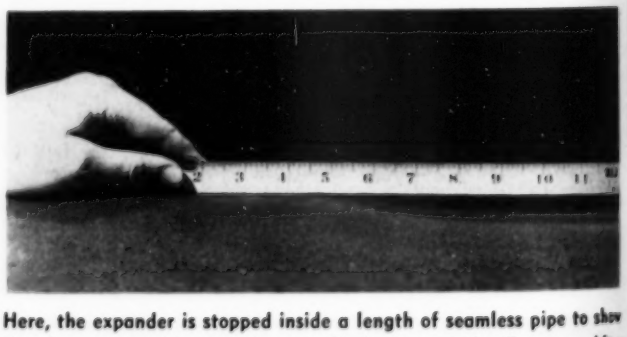
The expanding process used at Lorain shortens the pipe by several inches, depending on the size of pipe and the degree of expansion. Thickness of the pipe wall is only slightly reduced. Straightening and inspection follow the expansion.

Final operation in the process is to test each length of pipe to specified test pressures—pressures considerably greater than those to be experienced in the field. This is done by hydrostatic pressure. ■



Next, the pipe is placed in position for expanding (above and below). A plug weighing nearly 1000 lb is attached to the end of a long mandrel bar. This two-piece plug consists of a heavy point followed by a highly machined alloy ring, which does the actual expanding. To withstand the great force, the mandrel bar is made from 14-in. heavy-wall seamless pipe. The mandrel bar, (lower left in the above photo), which is powered by a 500-hp motor, is inserted into the circular expanding plug unit, which is then forced through the pipe at a rated 300,000-lb thrust. The outside diameter of the pipe shown here was increased to 24 in. In the lower photo, the cold expander operator is moving the plug that has been installed on the end of the mandrel bar into position to begin the cold expansion.





Here, the expander is stopped inside a length of seamless pipe to show the degree of cold expansion—to 24 in. in outside diameter. After leaving the opposite end of the pipe, the plug drops off the mandrel bar onto an elevator which lowers it to a conveyor for transportation back to the original point. Another elevator raises the plug into position for the next thrust. During full operation, five plug units are circulated to maintain smooth operation.

Part 6 in a Series

The New Gas Transmission and Distribution Piping Code

ASA—B31—SECTION 8

A background discussion by **FRED A. HOUGH**

Corrosivity of gases and soils and the prevention of over-pressuring

This article continues the discussion started last month on Chapter IV of ASA B31.1 Section 8 — Gas Transmission and Distribution Piping.

THE stress levels and design procedures for pipelines prescribed by the code are all based upon the assumption that the gas to be transported is substantially non-corrosive and either the soil in which the pipe is installed is substantially non-corrosive or suitable steps are taken to prevent corrosion. The code prescribes that, if a corrosive gas is to be transported or if suitable means of preventing corrosion in corrosive soils are not to be provided, the thickness of the pipe shall be increased to provide an allowance for corrosion. In such cases, the minimum corrosion allowance shall not be less than 0.050 in. for external corrosion and .0075 in. for internal corrosion. If both external and internal corrosion are to be expected, both allowances are to be added. No corrosion allowances are required in piping to be operated at stress levels of 20% of the specified minimum yield strength or less. However, the code states that the installation in corrosive soil of unprotected pipe with wall thicknesses as thin as the minimums permitted by the code is not recommended even for low pressure distribution systems.

Non-corrosive gas

Getting back to corrosion allowances for high pressure transmission lines, questions naturally arise as to what is a substantially non-corrosive gas and what is a substantially non-corrosive soil. In answer to the first question, the code says, "For the purpose of this code, any fuel gas of commercial grade, the water dew point of which is at all times below pipeline temperature, shall be considered to be substantially non-corrosive unless experience with it has indicated otherwise. Some fuel gases may be substantially non-corrosive even though their water dew point exceeds pipeline temperatures. Such gas shall, however, be assumed to be non-corrosive only if proven so by careful tests or experience."

Suitable protective coating

The questions as to how to determine the corrosivity of a soil, or what is a suitable protective coating to prevent external corrosion in a given situation, are questions upon which the code committee was unable to agree. Although some types of pipe coatings are very generally used and have proven to be quite effective, very few standard specifications for either the components of protective coatings or for the design and application of a coating have been developed by recognized and authoritative specification writing bodies. Without these, the code committee found that it could not prescribe, recommend, or even mention specific coatings without running the risk of placing other coatings that might be equally good at a serious disadvantage.

The use of cathodic protection, or the possibility of its use, further complicates the code-writing problem. A protective coating that might be quite inadequate without cathodic protection might be sufficient with cathodic protection, providing the cathodic protection is applied skillfully and with continuing qualified supervision. Consequently, the code committee has had to limit itself to requiring that, if stress levels approaching the maximums permitted by the code are used, corrosion must be held to very minor proportions. The methods by which this is accomplished are left to the owner.

Accidental over-pressuring

The accidental over-pressuring of gas transmission or distribution facilities has led, in the past, to some serious accidents. While most accidents from this cause have occurred in distribution systems and most of the material in the code, on pressure control and pressure limiting, deals with the problems encountered in distribution systems, the code does set up some very specific requirements regarding the limiting of pressure in transmission lines. The basic requirement for protection against accidental over-pressuring is:

"Every pipeline, main, distribution system, customer's meter, and connected facilities, compressor station, pipe-type holder, bottle-type holder, container fabricated from pipe and fittings, and all special equipment, if connected to a compressor or to a gas source where the failure of pressure control or other causes might result in a pressure which exceeds the maximum allowable operating pressure of the facility, as prescribed by this code, shall be equipped with suitable pressure relieving or pressure limiting devices in accordance with the provisions of this code."

In prescribing types of devices that

The piping code . . . Operating, not design, pressures may determine proper settings

are suitable for preventing accidental over-pressuring, the code differentiates between the type of device required for the protection of facilities that might be bottle tight and the type of device required for the protection of facilities from which some gas is always issuing. Both must be protected. Bottle-tight facilities might include a pipeline, or a section of a pipeline between valves, in which there are no leaks or only small leaks and to which a continuous load is not connected. Another example of a bottle-type facility would be a pipe-type holder that can be shut off at times so that it is not supplying any load. Suitable types of protective devices to prevent over-pressuring of bottle-tight facilities are stated by the code to be:

a. Spring-loaded relief valves of types approved for unfired pressure vessels by the ASME, or

b. Pilot-loaded back pressure regulators used as relief valves and so designed that failure of the pilot system or control line will cause the regulator to open.

Automatic devices that shut off the supply of gas to a facility when the gas pressure reaches the set maximum can be used if some gas is always issuing from the protected facility. In such cases, leakage through the protective device while it is in the closed position cannot over-pressure the protected facility.

Pressure control

The control and limiting of pressure in low- and high-pressure gas distribution systems is a more complex problem from the code-writing standpoint than that presented by transmission lines. The code recognizes that if a pipeline or distribution system is operated for a long period of years at a pressure well below the design maximum pressure and substantial corrosion has occurred during this period, there is a hazard involved in some cases in raising the operating pressure above previous maximum operating levels. Consequently, it is frequently the operating pressure history of a pipeline, main, or distribution system, rather than design pressure, that determines the pressure at which over-pressure protective devices should be set to act. In such cases, the maximum safe pressure is left to the judgment of the operating company. The only code requirement being that the operating company, having decided the maximum pressure it considers safe, shall install over-pressure protective devices to prevent accidentally exceeding that safe pressure.

The code prescribes safe procedures whereby the maximum allowable operating pressure of a pipeline or distribution system can be raised to a new maximum in those cases where past practices and physical condition, rather than design, determine the maximum allowable working pressure.

The code also prescribes safety precautions to be taken when a low-pressure distribution system is converted to a high-pressure system.

The accidental over-pressuring of low-pressure distribution systems has caused some of the most serious accidents in the gas industry. Consequently, the code committee gave special attention to this problem.

In this case, of course, the major hazard comes from the over-gassing of appliances, and the rupture of tin meters. The code prescribes that the pressure on low-pressure distribution systems shall not exceed either: "a., A pressure which would cause the unsafe operation of any connected and properly adjusted low pressure gas burning equipment or, b., A pressure of 2 psig." Either relief valves or shutoff devices (which interrupt the flow of gas to a system when the pressure on the system exceeds a specified amount) are acceptable means of preventing over-pressure.

Detailed analysis

The code, of course, does not attempt to spell out the detailed engineering analysis that is often required to verify that a low-pressure distribution system is adequately protected from accidental over-pressuring. Large distribution systems are usually supplied with gas from a number of pressure-regulating stations. It is sometimes assumed that if one regulator feeding the system sticks in an open position this will merely result in raising the pressure on the distribution system to the point where other regulators shut off and the load on the system will then absorb the excessive flow through the stuck regulator, and that the highest pressure attained on the system will be safe. While this may sometimes be true, the validity of such an assumption should be carefully tested in all cases by comparing the delivery capacity to the stuck regulator with the capacity of the low-pressure system to carry gas away from the stuck regulator. Usually when such a study is made, it becomes apparent that a zone of high pressure would build up around the stuck regulator and in that zone the pressure would be high enough to exceed the limit set by the code. It is also necessary, of course, to consider the possibility that valves in lines that interconnect high and low-pressure systems might be opened by mistake and the capacity of the low-pressure system to carry gas away from the valve is inadequate to prevent the development of a high-pressure zone in the vicinity of the valve.

Varied situations

The different types of accidents or situations that have resulted in the accidental over-pressuring of a low pressure system have been so varied in the past that considerable study and care is necessary in each system to make sure that low pressure systems are adequately protected. One very important precaution that is stipulated by the code is that protective devices must be designed and located where an accident, which causes the malfunctioning of a pressure regulator, will not also make the protective device inoperative.

The code also covers in some detail precautions that should be taken to prevent the accidental over-pressuring of meters and customers' facilities that are supplied from high pressure gas distribution systems. Certain specific requirements for house-type regulators are stated. In those cases where customers are supplied from distribution systems or pipelines operating in excess of 60 psig, it is necessary to install a protective device that will prevent over-pressuring of the customers' facilities in case the house-type regulator fails to shut off. Types of devices that the code committee considers suitable for this purpose are monitoring regulators, relief valves, or automatic shutoff devices.

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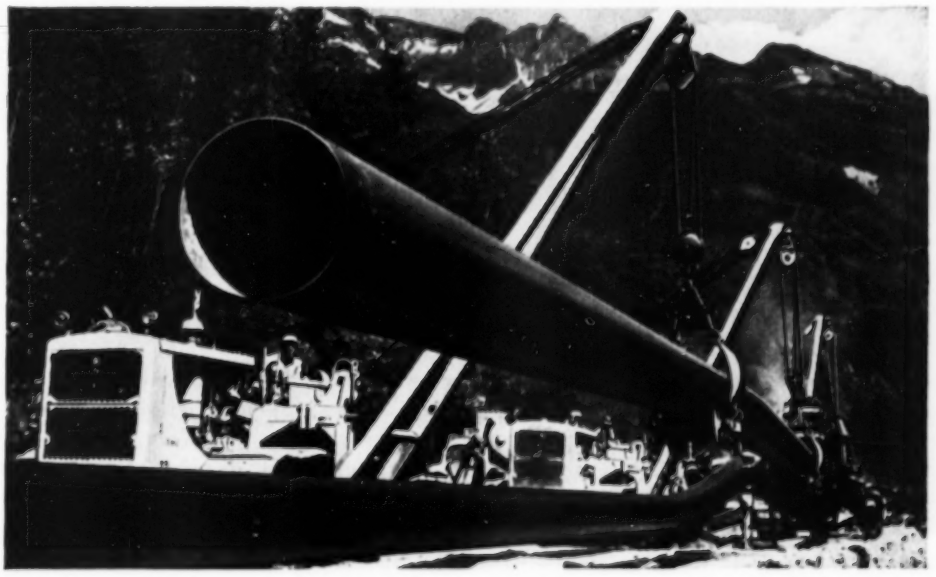
STRENGTH, DUCTILITY AND UNIFORMITY IN USS QUALITY HIGH TEST LINE PIPE



Only the highest quality gas and oil line pipe can effectively meet the needs of today's high pressure pipelines... like the 718-mile Trans Mountain Oil Pipe Line in rugged western Canada, using Consolidated Western 24" line pipe.

Consolidated Western's controlled quality manufacturing produces high strength, ductility, good welding properties and uniform diameter and wall thickness... assuring ease of installation and greatest service per ton of steel.

From two key sources, the new Utah plant and the Texas plant, Consolidated Western offers 20" to 36" diameter pipe to meet the exacting needs of pipeliners.

Quality control plus 100 years of engineering and fabricating leadership have combined to make Consolidated Western Steel, division United States Steel Corporation, your primary source of supply for high-test line pipe.

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DIVISION

UNITED STATES STEEL

Top of test bench, which provides space for the lubricator and a set of glass graduates, one for each of the individual lubricators.

PG&E services force-feed lubricators with company-developed test bench

AN INGENIOUS test bench, developed and built by machinists at Pacific Gas & Electric Co.'s Hinkley compressor station, has proven a valuable tool for the servicing of compressor engine force feed lubricators. Its advantages have been so readily recognized that it has also been adopted at Topock and Kettleman Hills compressor stations, the other two on the company's 30-in. line from the Colorado river northwest to San Francisco.

Equipment

Top of the bench (see photo) provides space for the lubricator and a set of glass graduates, one for each of the individual lubricators. The welded angle iron framework that supports the top also holds an electric motor and speed reducer for driving the lubricator shaft. An electric strip heater embedded in the top is used to bring the oil in the lubricator up to engine operating temperature.

When a lubricator is to be tested it is placed on the rear section of the bench over the strip heater with outlet connections facing the operator. A short bent copper tube is fastened to each of the outlet connections and graduates are located on the front of the bench to receive and measure the exact amount of oil delivered by each lubricator. A pulley is installed on the lubricator main shaft and is belt-driven from the electric motor.

The quantity of lubricating oil that should be delivered by each lubricator in hours of engine operation, according to engine specifications, is reduced to milliliters per hour for testing purposes. Once the oil in the lubricator has been brought up to operating temperature, an hour's run is made to determine the amount of oil delivered by each of the lubricators. The amount of oil delivered is read directly on each of the graduates.

A new lubricator is always tested for oil delivery before installation. Each lubricator that has been in use is also tested in the same manner as a regular part of the engine overhaul schedule. If an adjustment is required, a second hour-long run is made to assure the accuracy of adjustment.

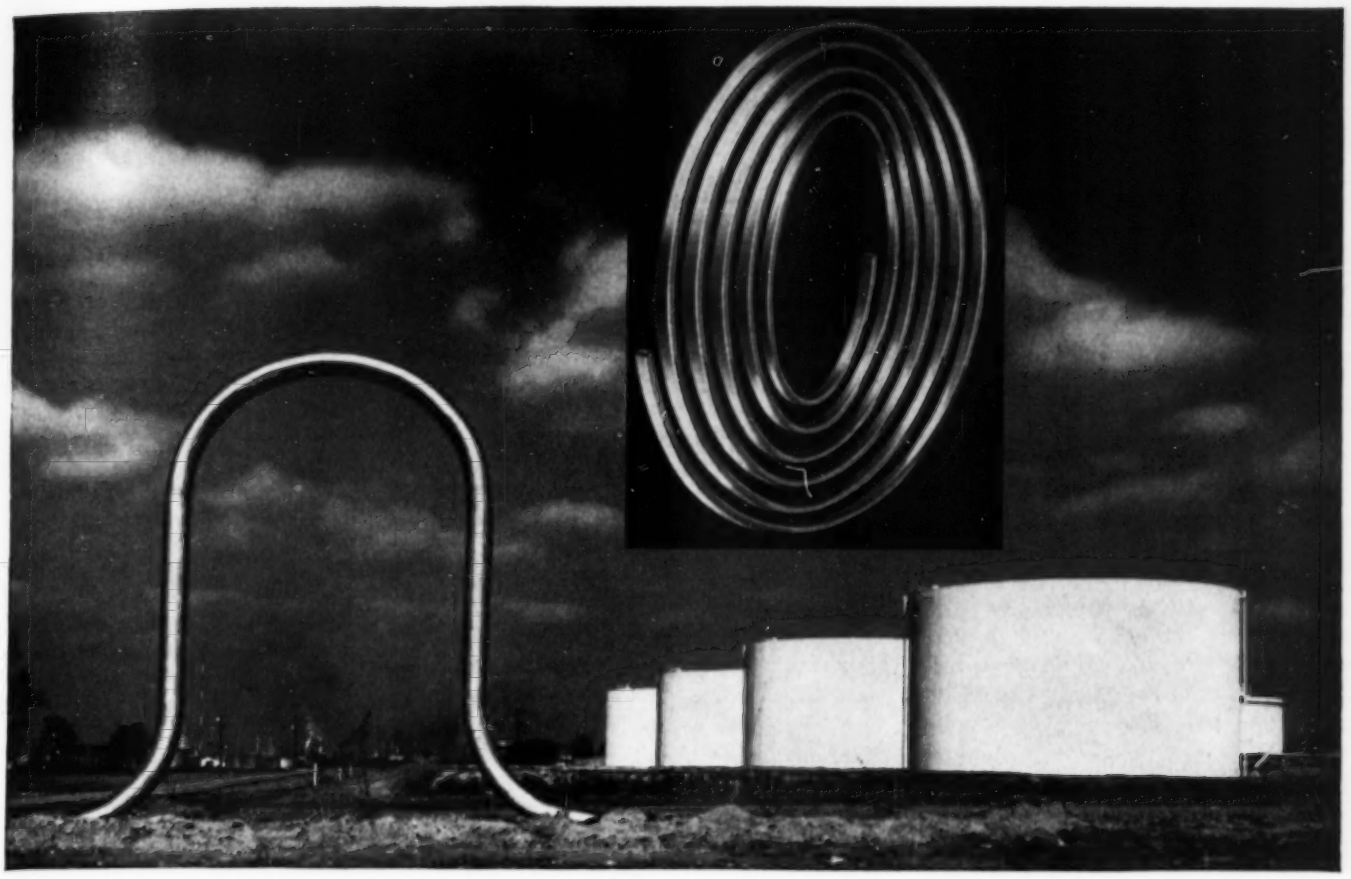
GAS exclusive

Work area

The test bench is a part of a small work area including a work bench and spare parts bins provided in the station's machine shop for the express purpose of servicing and testing lubricators. If, as part of the regular overhaul program, the lubricator is found on initial test to deliver too much or too little oil, it is dismantled for inspection. The entire lubricator is cleaned, and cam, cam lobe, and rocker arms are inspected for wear. Worn parts are replaced and the unit adjusted and retested for correct oil delivery.

As a part of the regular lubricator maintenance program, each of the lubricators is also pressure-tested to around 800 lb. A 1000-lb pressure gauge is fastened to the lubricator in place of the copper tube and the lubricator is pumped up to test pressure. ■

DOW



GALVO-LINE CUTS GALVANIC PROTECTION COSTS

Dow's magnesium ribbon anode gives you the most economical pipeline protection

When considering galvanic protection, think first of Galvo-Line®—the most economical method of pipeline protection—unique for its fast, mechanized installation.

While Galvo-Line was designed specifically to cut installation costs, field tests indicate that anode life has not been sacrificed. Properly designed installations in many soils offer as much as 10 years of effective life, and yet retain the other reliability factors expected of galvanic protection by magnesium anodes. There is no risk, for example, of trouble caused by power line failure, rodent attack on insulation, or dried-up ground beds.

Given reasonable conditions, Galvo-Line can be installed at rates upward of 3,000 feet per hour—the equivalent of installing 35 Galvo-Paks® in the same time. Connection-making costs are also reduced—one connection every 500-1000 feet will usually suffice. Uniform distribution and efficient utilization of current contributes greatly to Galvo-Line's economy and dependability in galvanic pipeline protection.

For the complete story, call your nearest distributor of Dow anodes or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, MA-335T.

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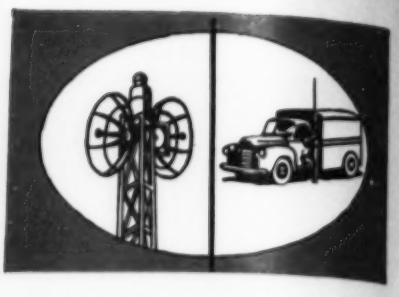
communications



By FRANK CHAPMAN

Joint action in mobile equipment field planned by communications men

GAS industry communications men, meeting in Pittsburgh during the annual AGA gas supply, transmission and storage conference, took a look at the future of the gas industry insofar as it is related to the requirements for communications facilities. Particularly interesting were discussions of telemetering and remote control over communications systems, equipment maintenance problems, and new developments in mobile radio.

Luncheon sessions held on both days of the two-day conference were presided over by H. A. Rhodes, chairman of the communications committee of the AGA operating section.

Industry relations with common carrier services came in for considerable discussion during the first day's session. Mr. Rhodes discussed the matter of common carrier interconnecting charges, contracts and agreements; and D. R. Wofford talked on leased service experience.

Following a discussion of 12-volt automotive electrical systems, the committee took action to study a recommendation for standardization among the automobile manufacturers. The group's exploratory study was expanded to include changes in automobile design and the design of mobile radio equipment to facilitate the installation of radio equipment.

The committee proposes to join with representatives of the NCUR, the API communications group and similar units in the public safety, industrial and taxi radio groups. It was pointed out that all of these groups have a common problem in the installation of mobile radio equipment.

* * *

The newest gas pipeline microwave system is soon to be installed by Texas Gas Transmission Corp. between Owensboro, Ky., and Lake Charles, La. The 700-mile system, to include some 30 repeater stations, is expected to be in operation by early 1956.

The system is initially designed for about 20 channels over various portions of the system and will include talking and telemetering circuits. The system may be eventually expanded to some 50 or 60 channels to include teletype, facsimile and the remote operation of IBM equipment for accounting purposes.

Of particular interest is the fact that the system is designed for private line service between any two stations along the route of the line. The design will cut out all intermediate stations during a station to station contact.

New mobile unit extends radio coverage

A new two-way mobile radio unit for use in the 25-54 mc. band that develops up to 110 watts of power output, and provides up to 40% greater communication coverage, was announced by the General Electric Co. at the recent Petroleum Industry Electrical Association's annual convention in Houston.

For demonstration purposes, an operating, front-mount unit was connected to a watt meter so that visitors, by turning on the transmitter, saw actual power outputs of up to 110 watts.

The new mobile unit, most powerful of General Electric's new progress line of two-way radio equipment, is available for either under dash or truck mounting.

A new dynamotor power supply, and the use of two GL-6164 tubes as final amplifiers, make possible the new super power unit. The dynamotor is rated at 640 volts and 275 milliamperes.

While battery drain of the new unit is approximately 65 amperes at 6.3 volts while transmitting, the normal amount of transmitting time is so small that standard heavy-duty generating systems give satisfactory service. Standby battery drain is 11 amperes at 6.6 volts.

Further information on the new super power mobile unit is available from local GE communication counselors, or GE Communications Equipment, Electronics Park, Syracuse, N. Y.

Report available on radio in drilling and producing

A comprehensive report on "Two-Way Radio in Petroleum Drilling and Producing Operations" has been released by the Central Committee on Radio Facilities of the API.

The report is the result of a special study on the application of two-way radio in petroleum production that was started in late 1953 by the central committee because of the importance of radio communication to these operations. It is prepared to "give a broader understanding of the vital role which radio plays in petroleum and natural gas production, not only under emergency conditions which frequently arise, but just as importantly, in the regularly established day-to-day operations."

The report specifically describes the use and need for two-way radio communication facilities in such fields as drilling, producing, offshore drilling and producing, desert drilling and producing, and offshore radar triangulation. Two instances where radio communication proved valuable at times of emergency are described.

The report also outlines the current status of the radio frequency spectrum allocated to the Petroleum Radio Service.

A limited number of copies of the report are available upon request to Joseph E. Keller, Special Representative, Central Committee on Radio Facilities of the API, Munsey Bldg., Washington 4, D. C.

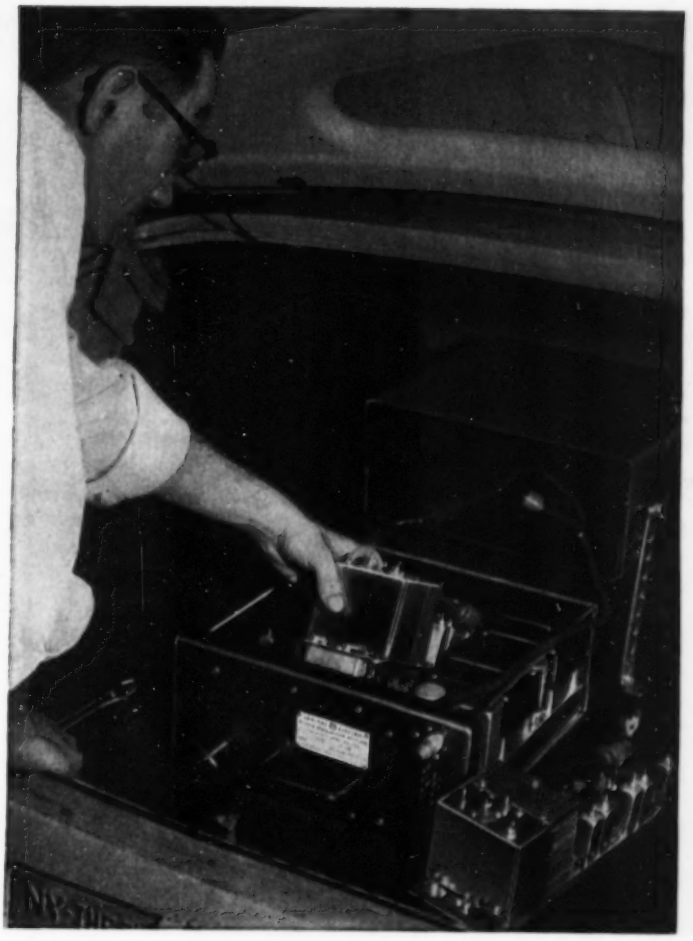
G.E. DEVELOPS NEW PLUG-IN CHASSIS FOR 2-WAY RADIO

NEW PROGRESS LINE saves money on maintenance through faster servicing—protects from obsolescence because chassis are quickly interchangeable.

IN the new Progress Line, transmitter, receiver, power supply and optional chassis are individually rack-mounted in a triple-rigid mobile case. Rapid interchangeability is provided by this rack construction and true plug-in chassis. This plug-in design permits changes in frequency, power, type of reception (narrow or wide band) quickly *at minimum cost, at any time.* You're free of any obsolescence risk!

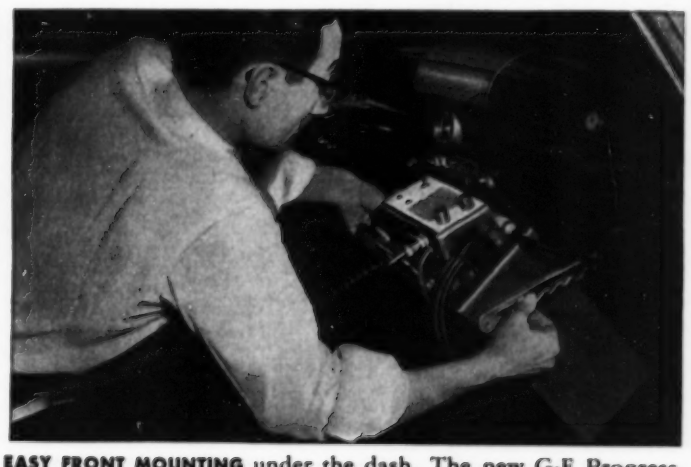
You may switch Progress Line mobile units—whether front or trunk mount, between vehicles with 6 or 12 volt DC systems. No electrical alterations are needed. And any mobile combination can be converted quickly to a low-cost, 117 volt AC intermittent duty base station by changing only the power supply chassis!

Let a G-E Communications Counselor analyze your radio needs and develop an installation or conversion program planned for long-run savings. Write or call today for full specifications on the new PROGRESS LINE. *General Electric Company, Communication Equipment, Section X1365, Electronics Park, Syracuse, N. Y.*



INDIVIDUAL PLUG-IN CHASSIS minimize capital investment in spares and reduce radio maintenance time! Your vehicles will be back "in service" faster. For instance, you can replace either a transmitter or receiver plug-in chassis right in the vehicle in 5 minutes—using only a screwdriver. Individual plug-in chassis of the new General Electric Progress Line units also provide complete interchangeability between mobile and station transmitters and receivers.

◀ **There is a G-E Authorized Service Station near you. Look for this sign.**



EASY FRONT MOUNTING under the dash. The new G-E Progress Line case is less than 15" deep. For the first time you can have a 90-watt front mount mobile unit in the 25-54 MC band and a 50-watt front mount mobile unit in the 144-174 MC band. In the 25-54 MC band you can now have simultaneous monitoring of 2 channels, in the same case, without additional equipment.

Progress Is Our Most Important Product

GENERAL ELECTRIC

NCUR holds annual meet

At its annual meeting recently in Minneapolis, the National Committee for Utilities Radio took action to study modification of operational rules to permit limited control facilities on mobile frequencies. Purpose of the study is the use of tone signaling for the remote operation of facilities such as valves from mobile equipment.

The committee also went along with other groups on the matter of channel splitting with a request for a relaxation of frequency tolerance.

In another action the committee officially announced the appointment of Joseph E. Keller as special representative in Washington, D. C.

Officers elected for the year were: Robert W. Lewis, Boston (Mass.) Edison Co., chairman; T. G. Humphreys, Alabama Gas Corp., Birmingham, vice chairman; and George Carlson, Consumers Public Power District, Lincoln, Neb., secretary.

PUC grants lease-maintenance agreement

With Southern California and Southern Counties Gas Co.s agreeing to pay an annual charge of $126,600 to Pacific Telephone & Telegraph Co. for maintenance, the California Public Utilities Commission has authorized the lease and maintenance of the radio facilities of the companies by the telephone company for $358,000. (See GAS, March, page 168 and May, page 154.)

In an earlier opinion, the commission had claimed that the annual maintenance charges were insufficient by $12,000 a year to cover the entire costs, plus a 7% return on the investment. The gas companies have now agreed to meet the commission's condition. (See Regulatory and Legislative Trends in this issue.)

Four methods of financing storage gain acceptance

The unique problem which the growing use of underground storage has brought to the gas industry — short-term financing of seasonal "merchandise" — has four principal solutions, all of which are presently being used by one or more of the gas companies involved.

Ordinary short-term loans on inventory such as the ordinary merchant obtains to cover peaks and valleys in merchandise selling will not apply in the gas business. While the merchant who must stock up for big events such as Christmas and Easter can pledge his stock as security, the gas company is dealing with a commodity that is fugacious and migratory, impossible to idnetify or inspect and equally impossible for the layman to measure while it reposes in the ground.

The merchant is frequently required to pledge his inventory; should he default, the lending agency can take possession and sell it to recover its loss. He may also be required to store the products in an independent warehouse where the proprietor acts as agent and releases the goods only as the borrower makes payments on the loan. Or a portion of his own warehouse may be partitioned off for the same purpose.

In addition to the inherent physical characteristics of the gas that make such procedures difficult if not impossible, there's the legal question as to whether a lien against gas in storage would be enforceable unless the pledge of the gas were accompanied by a first mortgage on the physical properties constituting the storage pool. Since most companies that store gas in substantial volumes have first mortgage bonds outstanding, a separate mortgage on the storage facilities would be impossible. In addition, debenture bond indentures and term loan agreements frequently contain convenants forbidding the creation of liens which would prevent the pledge of gas in storage.

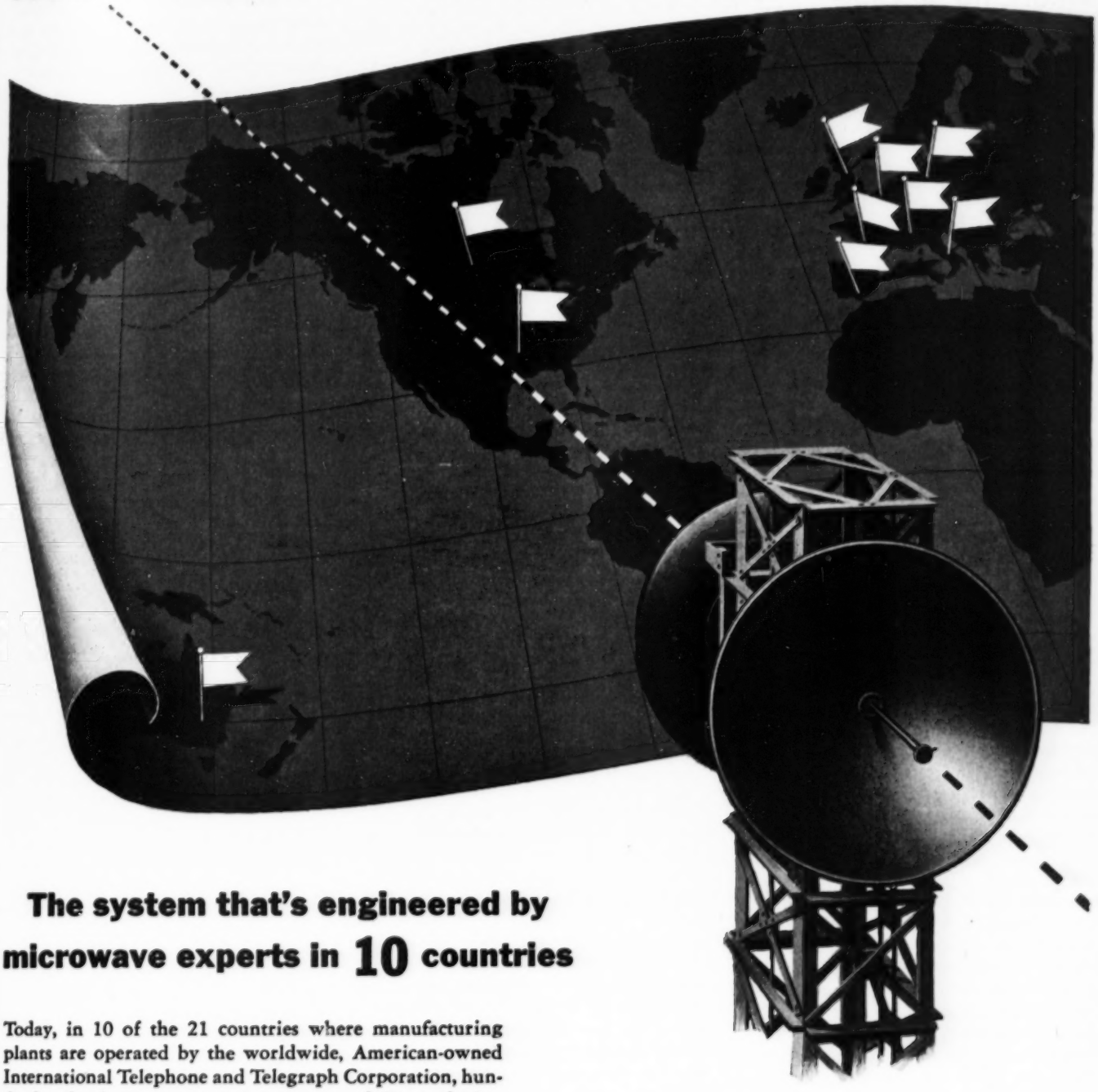
It might be asked at this point why short-term financing is needed at all. It is common knowledge that in a storage proposition the cash comes in heavy in the winter, goes out heavy in the summer. But why shouldn't a company keep enough cash reserves on hand to take care of this need, particularly since it's a regular seasonal requirement occurring every summer? The answer is that this reserve would have to come from additional long term debt or stock issues or by accumulating and retaining in the company's treasury cash that otherwise might be used to retire long-term securities. Such a policy would be uneconomic—having outstanding securities, on which interest and dividends would have to be paid throughout the year, for benefits that could only be realized for a short period of the year.

Admitting the necessity of obtaining short-term loans, but also taking into account the difficulties in giving adequate protection to the lender, the lending agencies have been placed in a position of having to develop several types of loan arrangements. Fortunately, the credit of the gas companies is good so the lack of security is not preventing them from obtaining this type of credit.

These considerations, and the following discussion of the prevalent methods of obtaining financing, were the subjects of a talk on "Financial Aspects of Underground Storage," presented by A. B. Bowden of Mellon National Bank & Trust Co. before the AGA transmission conference held in Pittsburgh May 9-10.

ONE financing arrangement now in use is the establishment of a simple line of credit. Under this plan a bank writes the company a brief letter stating that it is willing for a stated period, commonly a year, to make loans to the company from time to time as required, in amounts not to exceed a stated maximum. As gas is being placed in storage and funds are required, the company from time to time borrows from the bank, giving it notes drawn to mature three months, six months, or nine months from the date of issuance but not later than the end of the period specified in the bank's letter. The notes bear interest at the bank's prime rate

FEDERAL MICROWAVE—"CERTIFIED BY A WORLD OF RESEARCH"



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Export Distributors: International Standard Electric Corp., 67 Broad St., New York

Financing storage . . . Flexibility is a prime requisite with any method

(i.e., the rate at which it is currently lending on short term obligations to customers of the highest credit rating), or they may bear interest at a rate fixed at some percentage over the prime rate such as ¼ of 1%. Most gas companies are entitled to the prime rate. In any case, the interest rate applicable to an individual note is determined in relation to the prime rate on the day the note is issued. The notes may be prepaid at any time without penalty and the company pays them off as funds are generated during the period when gas is being withdrawn from storage. This is a simple financing arrangement but a satisfactory one.

A second arrangement is more formal. Under it a bank enters into a credit agreement with the company in which it is provided that loans will be made to the company in stated amounts and on stated dates. The dates, of course, are distributed through the months when gas is normally being placed in storage and both the dates and amounts are determined in relation to the company's forecast of its requirements. The agreement also fixes certain dates during the heating season upon which the notes will mature and sets the amounts to be repaid on the various maturity dates. The interest rate is set forth in the agreement and all notes issued under it bear the same interest rate. In consideration of the fixed schedule of borrowings and repayments, the bank normally does not charge a commitment fee on the unborrowed balance of the credit. Under this arrangement, a problem may arise if, in actual practice, funds are needed before the dates indicated in the forecast or if the funds for the repayment of notes are not available on the scheduled maturity dates. In such cases, the company may request the bank to approve a change in the dates or amounts and ordinarily the bank would be quite willing to grant the request.

Lacks flexibility

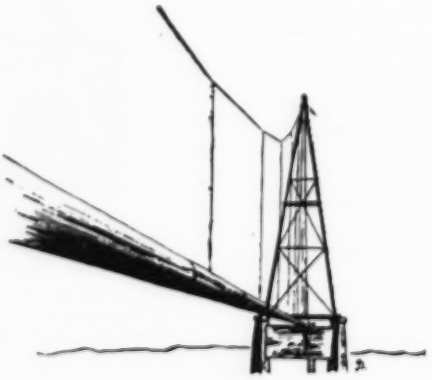
This arrangement does not have the flexibility of the one previously mentioned but it does have the advantage of an interest rate that is fixed for the term of the agreement and is not subject to change if there is an increase in the bank's prime rate.

In our bank we have developed a financing plan that has worked very satisfactorily where it is in use. Under this plan we enter into a credit agreement with the company in which we agree to lend up to a stated maximum amount. A regular settlement date is fixed, such as the 10th or 15th of the month, and each month on that date the company delivers to us a certificate showing, as of the end of the preceding month, the amount carried in Account 134 of the Federal Power Commission classification of accounts, representing the dollar value of gas in storage other than cushion gas. Upon receipt of the certificate the loan is increased or decreased to make it equal to the amount shown in the certificate.

Of course, the company is not compelled to borrow the full amount indicated in the certificate if it does not need the money. Borrowings under the plan bear interest at our prime rate or at a fraction of 1% above the prime rate as in the case of the line of credit mentioned previously. If there is a change in the prime rate, we make a corresponding adjustment in the rate applicable to borrowings under the plan at the beginning of the following month.

"Accounts payable"

Borrowings are not evidenced by notes and, as a result in some cases, it has been possible for companies to carry them as "accounts payable to banks" or simply as "accounts payable" rather than as "notes payable." The credit agreement ordinarily has no fixed termination date but continues indefinitely subject to termination upon proper notice by the company on any settlement date or by the bank at the end of any gas storage season. We feel that this plan provides a continuing arrangement under which borrowings are directly related to the value of gas stored and in addition, the borrowing is in a form such that it may be possible to avoid showing them in the balance sheet as "notes payable."

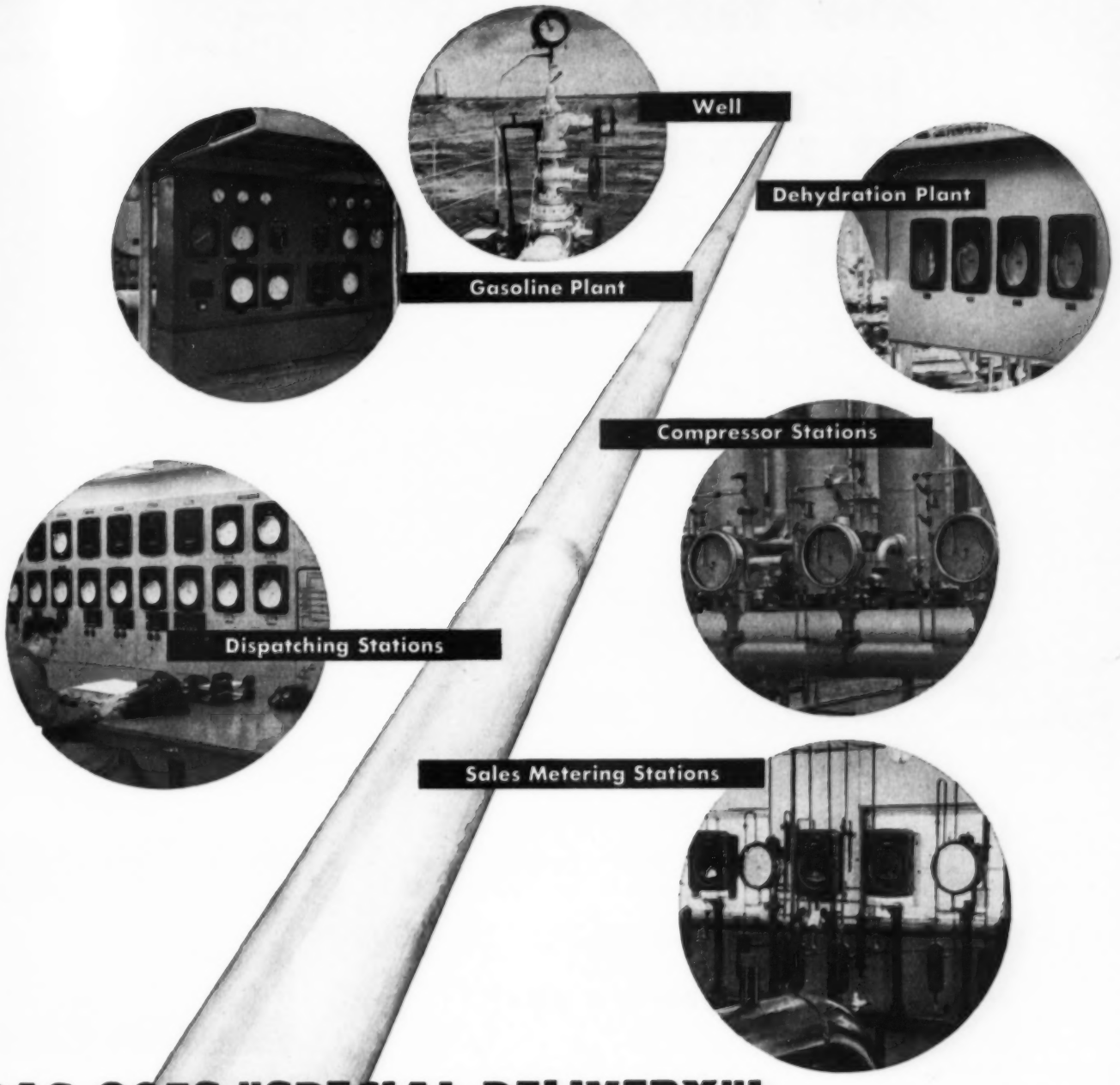


A fourth form of financing utilizes commercial paper, which is short term unsecured promissory notes that are not issued directly to banks but instead are sold in the open market through investment banking and brokerage firms (which receive a commission for their services). The notes have stated maturities such as three months or six months from the date of issuance and the yield to the purchaser is established in line with the market for commercial paper at the time of issuance with some adjustment for the credit standing of the issuing company. Since they are held by widely scattered investors of various types, the notes must be paid exactly at maturity. No prepayments or extensions of maturities are possible if, in actual operation, the flow of cash into the company during the heating season does not conform with the maturity schedule. This form of financing, therefore, has the advantage of a lower rate of interest but is not as flexible as those previously mentioned.

Background difference

Companies differ greatly in their business background and in their general financial policies and the choice of a financing plan will be governed to a large extent by those considerations. However, there are two basic principles that are applicable generally. First, a company's financial program will be more orderly if the financing of gas storage is handled under a separate arrangement rather than commingling it with other financial requirements. The financing of gas storage is a problem that arises regularly each year and will continue to do so to an increasingly important degree. It should be analyzed carefully and a program developed that will provide the required funds more or less automatically and make it unncessary to reconsider the subject year after year.

Secondly, I feel that the prime requisite of an adequate financing program is flexibility. What is needed is a source of funds that can be drawn upon freely as required during the period when gas is being injected into the reservoirs and can be repaid just as freely as the gas is withdrawn. No matter how accurate our forecasting procedures may be, the movement of gas in the last analysis is determined by the weatherman. A late, warm fall will delay the withdrawal of gas from storage and an extended warm period in early spring may mean the retention of an unexpected amount of gas in storage until the next heating season. The financing program should be such that it will adapt itself to variations from normal weather without the necessity for reconsideration and major adjustment.



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From well to city gate, natural gas flows more efficiently, with less supervision, in Foxboro-instrumented pipelines. At every stage — production — processing — transmission — delivery — Foxboro Instruments measure and automatically control gas movement and related operating variables. The resulting highly integrated control system keeps loads perfectly balanced . . . vital equipment constantly protected. For information on the latest methods of pipeline control, contact your nearby Foxboro Sales Engineer, or write **The Foxboro Company, 346 Norfolk Street, Foxboro, Mass., U.S.A.**

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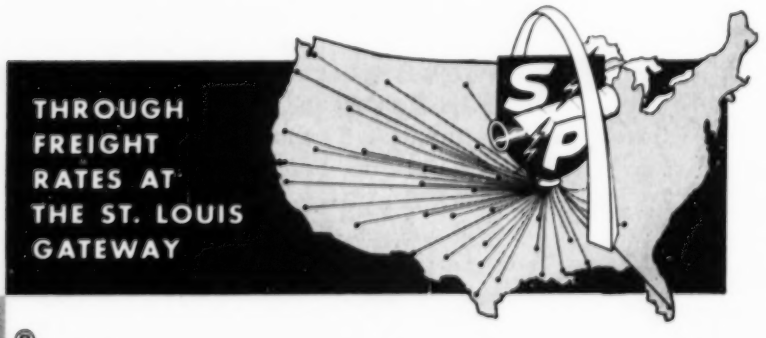
FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

ARE THERE HOLIDAYS IN YOUR FUTURE...

or in the future of your c/w pipe?

SPI is the only c/w company that steel grit cleans every piece of pipe, regardless of size, because steel grit cleaning produces the perfect surface to bond the coatings to the steel. Bond performance, over the years, is better.

If you want holidays for yourself, and not for your pipe, have it coated and wrapped at SPI under ideal conditions.



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standard pipeprotection inc.

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GAS new pipeline products

(For additional information, use coupon on page 84.)

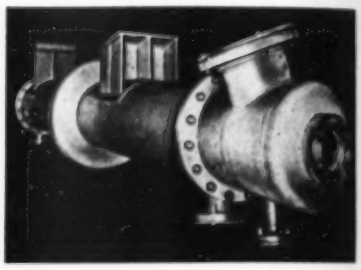
16 Line-up Clamp

A new outside line-up clamp for the pipeline industry has been designed by Cinch Clamps Inc. for tie-in, fabrication, and construction jobs.

The lightweight clamp does not have cross-bars and the manufacturer claims that sledging has been practically eliminated. The clamp aligns pipe for perfect stringer-beads and operates in any position. It has a heavy-duty ratchet designed especially for Cinch clamps.

Cinch Clamps Inc.

■



17 Heat Exchangers

A new line of semi-standard heat exchanger units designed to meet a variety of heat-transfer problems has been announced by Downingtown Iron Works.

Numerous optional design features may be specified: nozzles may be of any size or in any location required by the location and units may be specified with or without an expansion joint. The semi-standard units are available in stainless steel or carbon steel.

Thickness of the tube sheets is ⅞ in. and up and thickness of bonnets and channels is 3/16 in. Small stainless steel nozzles are Schedule 40 stub ends with ASA lap-joint flange. Units have been designed for pressures of 150 psi and higher.

Standard shell diameters available are 5, ,6 8, 10, 12, 14 or 16 in. in various lengths in each size.

Downingtown Iron Works

WHAT'S NEW AT BRISTOL

NERVE CENTER. Central dispatching office of Valley Gas, where dispatcher John Bonner checks the readings of pressure, flow, and temperature at 49 points in the company's distribution system on Bristol Metameter Receivers.

New telemetering system checks 49 functions by phone!

104 COMMUNITIES in northern Mississippi are served by Valley Gas.

Mississippi Valley Gas Company uses Bristol Metameter* Telemeters in most extensive "Selective Calling" telemetering system

By simply dialing a code number on a standard telephone dial, a dispatcher can get a reading on a Bristol Metameter receiver of pressure, flow, or temperature from any one of 49 Metameter transmitters installed at 21 different field locations along Mississippi Valley's retail gas distribution system.

There are also Bristol Time-Multiplexing circuits installed at two communities. With these, the dispatcher can dial one code number and have seven readings from the community in question indicated at the same time on the panel board — thus reducing dialing time. The function and the location being received is indicated by a system of bullseye lights on the panel.

We'd like to tell you how Bristol Metameter Telemeters can help you, too. Write today for free 40-page booklet M1710. Address The Bristol Company, 119 Bristol Road, Waterbury 20, Conn. 4.39

Reg. U.S. Pat. Office

TRADE MARK BRISTOL'S REG. U.S. PAT. OFFICE

BRISTOL

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

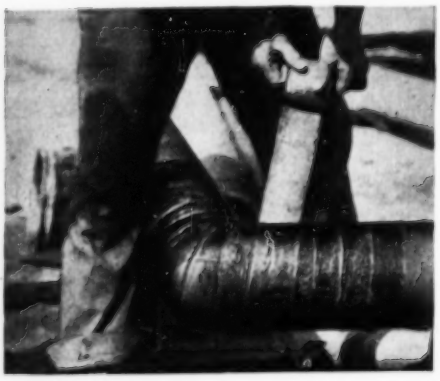
COMBAT CORROSION!

Specify TAPECOAT®

... the Original Coal Tar Coating in Tape Form for Pipe, Pipe Joints, Couplings and Tanks

TAPECOAT is a coal tar coating with a tar-saturated close-woven fabric as a carrier for speed of application. The coal tar is self-bonding and requires no foreign adhesives.

Because coal tar is nature's own protection against corrosion, TAPECOAT resists moisture, acids, alkalis, soil stress, electrolysis, chemical fumes, fly ash, salt water, salt-laden air, barnacles, and other severe corrosive and abrasive conditions above and below ground.



TAPECOAT is clean to handle and easy to apply by spiral or "cigarette" wrapping with the use of a torch to bleed the coating to insure a continuous bond. It cuts maintenance and replacement costs.

TAPECOAT is sized to the job — comes in rolls of 2", 3", 4", 6", 18" and 24" widths to meet specific requirements on pipe, pipe joints, couplings, tanks, cable, conduit and other vulnerable steel surfaces.

PROVED IN SERVICE SINCE 1941

TAPECOAT has proved its dependability over the years in serving gas and oil companies, railroads, telephone companies, air lines, shipbuilders and operators, water and sewage works, chemical and industrial plants, engineers and contractors . . . providing continuing protection against corrosion.

Write for descriptive brochure and prices.

The TAPECOAT Company

Originators of Coal Tar Tape Protection

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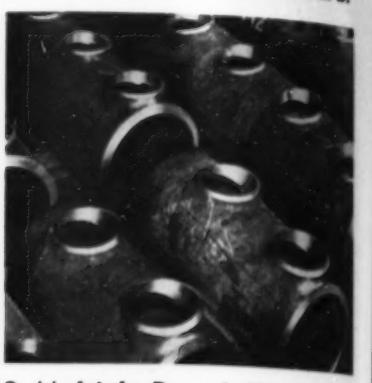
new products • Cont'd.



18 Multiple Branch Tee

A Tube-Turns multiple branch tee with integral extruded outlets has been introduced by Tube Turns. It makes possible a sound and economical solution to many header problems of piping for air conditioning and radiant heating systems.

The multiple branch tee, or full encirclement reinforcement, is for the larger diameter opening and working pressure developing hoop stresses exceeding 50% of the yield strength of the run pipe.

Tube-Turns tee is especially useful where branch outlets are appreciably smaller than the run pipe. Tailored to individual jobs, the new product's size, wall thickness and number and size of outlets are determined by individual service conditions. It is available in all commercial metals and alloys.

Tube Turns

■

19 Truck Tracks

Truck tracks like those pictured are being adopted by truckers and contractors facing mobile problems with trucks, tractors, cranes and similar rubber-tired, heavy equipment.

The truck tracks, available from the P & G Supply Co., fit most tires, are easy to mount, give up to 500% greater flotation, and are quickly and easily adjusted to various size tires and road conditions. P & G supplies them in standard tracks of 15 in. for single and tandem axles. Heavy duty 18-in. tracks are also available for many larger size tires.

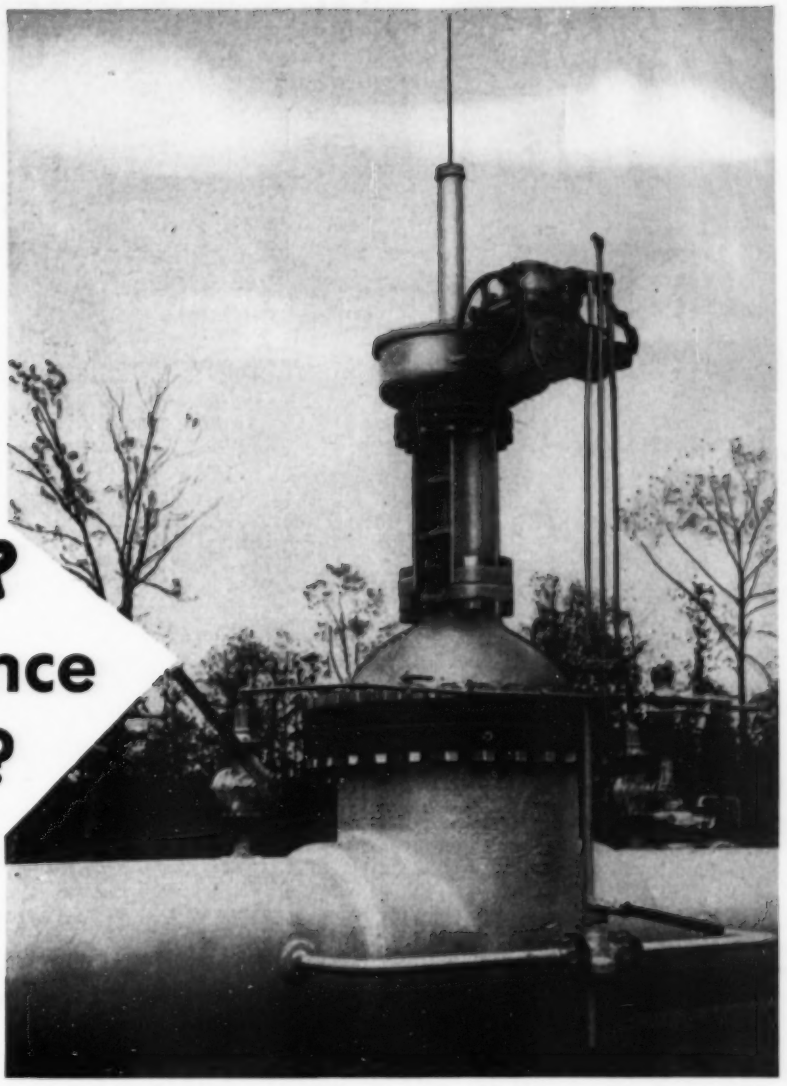
P & G Supply Co.

DARLING

DARLING

VALVES

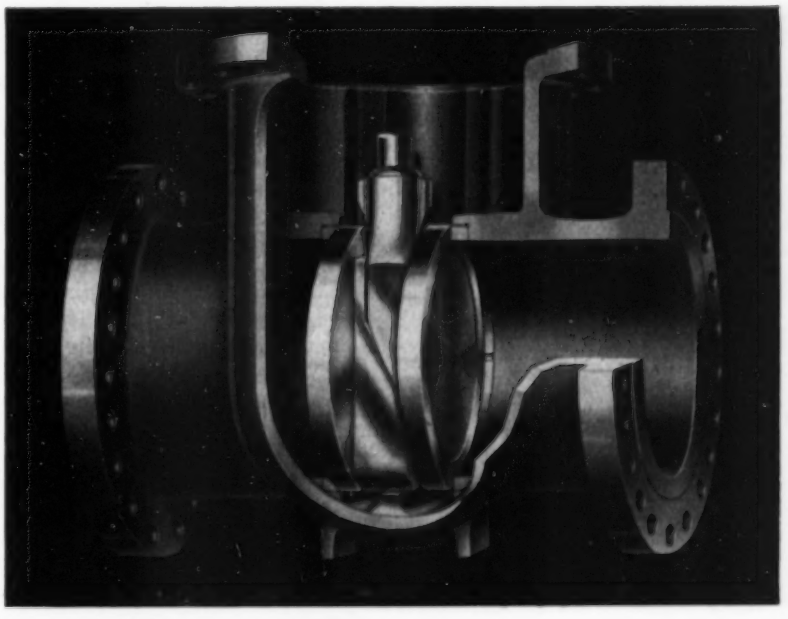
What's *SURER* valve performance worth to you?



IN your service, the thing about valves that costs the most is down time. Right? And sometimes even *preventive* measures are pretty costly, too!

All right, here's a fact that Darling gate valve users everywhere will vouch for. The Darling *fully revolving double disc, parallel seat principle* means *easier* operation, *surer* closure, less chance of trouble, month in, month out. And you'll save on maintenance all along.

Why not check into Darling gate valves for your requirements? Find out *how* they assure these advantages. We'll gladly furnish general or specific details. Just say the word.



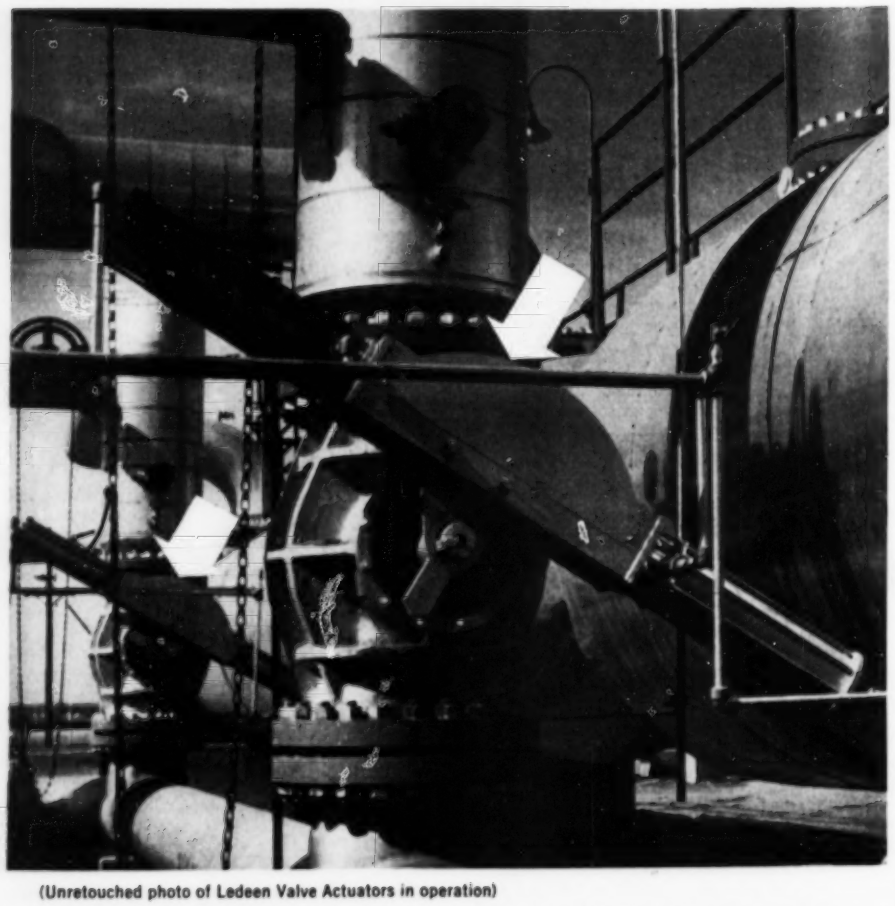
Above top: Darling 30" motor-operated gate valve powered by gas from line pressure.

Cutaway, below, shows simplicity of Darling's unique fully revolving double disc parallel seat gate valve principle—just four simple working parts—two plain interchangeable no-pocket discs and two husky wedges.

DARLING VALVE & MANUFACTURING CO.

Williamsport 26, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario



(Unretouched photo of Ledeen Valve Actuators in operation)

AMINE RECOVERY PLANT PLUG VALVES OPERATED BY LEDEEN VALVE ACTUATORS

Natural gas companies find these operators safe, positive, dependable for automatic operations

LEDEEN TIME
DELAY VALVE
When lightning strikes or power fails, this new valve keeps station on line. If power is not restored within adjustable time delay limit set by the valve (2 seconds to 2 minutes), station is blown down and lines vented. Write for data on this compressor station watchdog.

Ledeen Valve Actuators are used in compressor stations on automatic blowdown valves, fuel shutoff valves, relief valves, pipeline and station block valves, and many more applications along with the Amine Recovery Plant installation shown.

These valve actuators are pneumatically and hydraulically operated, do not leak and are easily mounted by field personnel without modification of plug valve. They can be mounted in any position around the valve; and are available with auxiliary manual operation, either at valve or at a remote location. For preventive maintenance, actuator and control system can be operated without turning the valve. Torque ranges from 500 to 500,000 inch pounds.

WRITE FOR BULLETIN 3020.

VALVES • CYLINDERS
VALVE ACTUATORS
AIR HYDRAULIC
PUMPS & BOOSTERS

Ledeen Mfg. Co.
1608 So. San Pedro St.
Los Angeles 15, Cal.

GAS trade literature

20 Compressor Brochure

A brochure entitled "Recent Advances in Engine and Compressor Design" has been published by Clark Bros. Co. describing in detail the company's new Clark turbocharged compressor designs.

Clark Bros. Co.

■

21 Pipelayer Brochure

A four-page brochure describes Caterpillar Tractor Co.'s new pipelayer. The brochure (Form 31407) graphically features points of outstanding design in the new 130,000-lb capacity machine.

Caterpillar Tractor Co.

■

22 Cooling Tower Bulletin

J. F. Pritchard & Co. of Californ has published a well-illustrated bulletin that answers 15 questions about Pritchard induced draft cooling towers for industrial and air conditioning applications.

J. F. Pritchard & Co.

■

23 Control Valve Catalog

Airmatic Valve Inc. has issued a 66-page catalog illustrating its entire line of two-, three- and four-way air control valves for high pressure or low pressure installations. Helpful information on outstanding features, application data, dimensions, specifications and parts list breakdown are provided.

Airmatic Valve Inc .

■

24 Pipeline Booklet

"Profitable Pipelining" is the title of a new 12-page booklet released by Caterpillar Tractor Co. Featured in the booklet are large photographs depicting all phases of pipeline operation.

Caterpillar Tractor Co.

■

25 Foundation Bulletin

Taylor Forge & Pipe Works has published Bulletin 542 describing characteristics of Taylor Forge foundation pipe for piling and illustrating its application in the construction of bridges and buildings. Sizes of pipe commonly used for piling are listed and driving ends preparations are shown.

Taylor Forge & Pipe Works

YOUNGSTOWN LINE PIPE EASY TO BEND

●Discuss this advantage with your men in the field. They will tell you that Youngstown A.P.I. Electric Weld Line Pipe is easy to bend. Youngstown experience permits control of chemical composition to get optimum ductility. This quality makes possible smooth, accurate, unwrinkled bends in the pipe line.

SPECIFY QUALITY V YOUNGSTOWN SERVICE

ELECTRIC WELD **LINE PIPE**

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

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GAS pipeline news

Volume of underground storage doubled in 5 years

The volume of gas in underground storage has more than doubled itelf in the past five years—as have the total storage reservoir capacity, total annual output, and maximum day output, according to the latest report of the AGA committee. The report was summarized for the annual gas supply, transmission, and storage conference in Pittsburgh May 9-10 by H. L. Freuchtenicht of the Michigan Gas Storage Co., Jackson.

Representing the status of the nation's storage pools as of Oct. 31, 1954, the report showed that the volume of gas in storage on that date was 1011 billion cu ft, a rise to 2.45 times the volume of 412 billion recorded for 1950, the first year the storage figures were compiled.

The new total was also 125 billion ft ahead of 1953.

Other impressive records, quoted from the study:

Total reservoir capacity, which includes all native gas remaining in the reservoirs when storage operations were started, increased 2.40 times for the five-year period. The volume in 1954 was 1859 billion cu ft as compared to a volume of 744 billion cu ft in 1950. This volume increased in the past year by nearly 125 billion cu ft.

Total output for the year ending Oct. 31 rose from a very low of 232 billion cu ft in 1953 to 304 billion cu ft in 1954. The volume increased for the five-year period since 1950 to slightly more than 2.10 times the 1950 figure. Inputs for 1954 were up about *30 billion* over last year, giving a total volume of *432 billion* cu ft into storage for the year.

GROWTH OF UNDERGROUND STORAGE OF NATURAL GAS

	Volume (MMcf)	% of 1950 Volume
Maximum Gas in Storage		
1950	412,106	
1951	546,720	132.7%
1952	777,003	188.5%
1953	889,138	215.8%
1954	1,011,335	245.4%
Ultimate Capacity		
1950	774,434	
1951	915,988	118.3%
1952	1,292,321	166.9%
1953	1,735,815	224.1%
1954	1,859,398	240.1%
Total Output Year Ending Oct. 31		
1950	143,435	
1951	200,435	139.7%
1952	234,792	163.7%
1953	232,559	162.1%
1954	304,205	212.1%
Maximum Day Output		
1950	2,591	
1951	3,241	125.1%
1952	4,101	158.3%
1953	4,213	162.6%
1954	5,564	214.7%

Maximum day output was considerably higher this year than the past year because of the colder winter in 1953-54. There was an increase over last year of *1351 MMcf.* When we compare the volume for 1950 to that of 1954, we find that it has risen from 2591 MMcf in 1950 to 5564 MMcf. This volume has increased 2.15 times during the five-year period.

In 1950 there were 125 storage pools with 3853 active wells in comparison to the year 1954 with 172 storage pools and 6395 active wells. There are also 12 pools in the new construction category.

In 1950 there were 83 compressor stations used for underground storage facilities with a total of 158,000 hp, compared with 115 stations having 300,000 hp in 1954.

Total capital investment, which includes both cushion gas and plant, is $343 million for the year ending Oct. 31, 1954.

Of the 17 states where storage is carried on, Virginia, Pennsylvania, Michigan, and Ohio are the leaders in all phases of underground storage (see tables).

Gas-for-irrigation bill passed by Oklahoma house

A bill to force Oklahoma oil companies to sell natural gas to farmers for irrigation purposes has been reconsidered and passed by the Oklahoma house.

The measure gives the farmers first priority on gas produced in their area. If the oil companies refuse to sell gas to the farmers, they can be sued for damages.

The author of the bill claims it will promote irrigation in the Panhandle and in western Oklahoma.

California oil man urges study of gas imports

The retiring head of the California Oil Producers Agency has urged a study of the effects that out-of-state gas have on California producers.

The investigation should include examination of utility policy regarding prices paid for imported and indigenous gas, prices charged classes of consumers, future plans for increased importation, and underground storage development.

Richard A. Grant told the annual

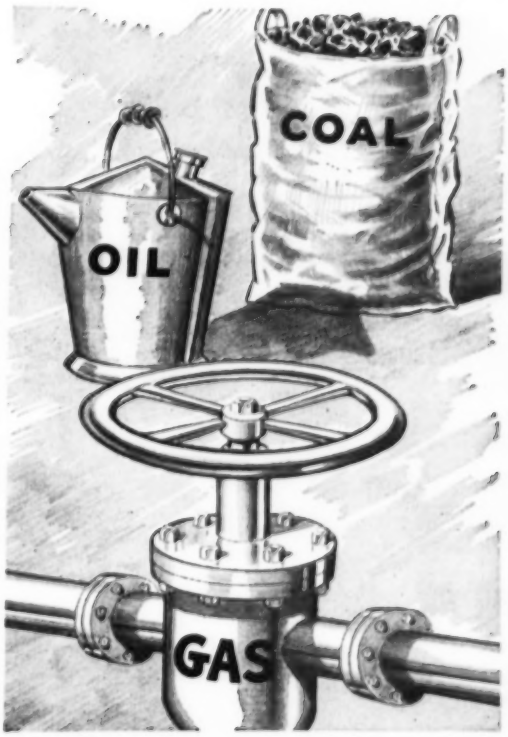
RANKING OF STATES IN UNDERGROUND STORAGE OPERATIONS

(MMcf) Year 1954

Maximum Gas in Storage		*Ultimate Capacity*		*Total Output Year Ending Oct. 31st*		*Maximum Day Output*	
Pennsylvania	266,301	Pennsylvania	417,717	West Virginia	68,764	West Virginia	1,148
Ohio	190,973	Michigan	304,862	Pennsylvania	59,915	Pennsylvania	1,046
West Virginia	160,797	Ohio	292,029	Michigan	49,327	Ohio	824
Michigan	91,996	West Virginia	250,568	Ohio	45,677	Michigan	752
Oklahoma	77,798	Oklahoma	195,036	Kansas	19,833	Oklahoma	468
Kansas	55,062	New Mexico	119,435	Oklahoma	16,576	California	379
New Mexico	30,475	Kansas	62,602	California	15,626	Kansas	238
New York	30,240	California	58,075	New York	9,366	New York	171
Kentucky	19,965	Montana	42,068	New Mexico	6,519	Illinois	158
Illinois	19,849	New York	35,900	Kentucky	5,622	Kentucky	126
California	18,713	Kentucky	24,833	Texas	2,061	New Mexico	83
Montana	14,388	Wyoming	23,896	Montana	1,553	Texas	55
Wyoming	14,313	Texas	16,640	Indiana	1,455	Wyoming	36
Texas	11,859	Arkansas	7,801	Wyoming	973	Indiana	36
Indiana	5,507	Indiana	7,073	Illinois	410	Montana	31
Arkansas	2,543	Mississippi	865	Arkansas	389	Arkansas	8
Mississippi	555	Illinois	—	Mississippi	139	Mississippi	5
	1,011,334		1,859,400		304,205		5,564

IN A FREE ECONOMY

Preference of the Buyer Will Keep Prices Properly Adjusted



AT THE ends of the gas lines that come out of the Southwest the customer has his choice of fuels—coal, oil or natural gas.

Gas has come along rapidly. In 1932 it provided fuel for less than 10 per cent of the nation's total energy needs; now it fulfills 25 per cent of those needs. Since it is the most convenient of the three, a proper conclusion would be that it would command the highest price.

Contrariwise, it happens to be the cheapest of the three fuels for home heating, on a price adjusted to efficiency basis. A recent study of eight cities, Chicago, Cleveland, Detroit, Minneapolis, New York, Pittsburgh, St. Louis and Washington revealed that gas costs less than the other two fuels in each of these except Washington. It is more expensive than coal in New York, where the comparison was with an especially screened anthracite product rather than bituminous coal. Only the nation's Capitol offers the home owner gas at a price higher than either coal or oil.

In time this may change. What is certain is that the home owner never will pay more for gas than he pays for coal or oil, unless he chooses to do so, since all three are available and he is free to select as his preference dictates.

What is more, should the price of gas get out of line, the home owner has the means of pulling it back by shifting to some other fuel. And this is a quicker and more effective regulation of price than can ever come out of the price-fixing deliberations of any bureau in Washington.

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meeting of the organization that one problem facing the oil industry is a surplus of fuel oil "attributable to a substantial extent to the volumes of gas being imported into the state."

Contending that the gas companies sell gas at "dumping" prices that fuel oil cannot compete with, he said ". . . We are confronted with the inequity of the California producer of gas having to sell his gas to the public utility companies at a lower price . . . than the cost of gas produced outside of California.

"Basically, two volumes of gas having substantially the same qualitative analysis should be of equal value to the utility company purchaser.

"In fact," he continued, "it seems to us that a thousand cubic feet of gas produced by a California operator for use here has greater value than an equal quantity produced elsewhere."

He believes that with more underground storage capacity the California utilities would need less additional out-of-state gas, there would be less interference in the fuel oil market, and the whole economy of the California oil industry, and of the state, would be strengthened.

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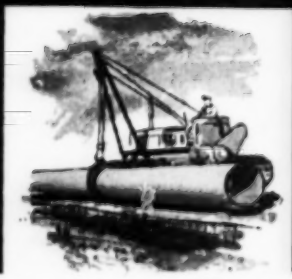

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Gulf Interstate to build unattended station

An experimental unattended "satellite" natural gas compressor station will be built near Stanton, Ky., by Gulf Interstate Gas Co., Houston, under a certificate issued by the FPC (Docket G-6863).

The station will be controlled by personnel at a station 80 miles away at Clementsville, Ky., Gulf Interstate said. The company plans to operate the experimental station on a standby basis for a 15-month test period to determine the economics and feasibility of the non-attended operation.

The units, to be installed on Gulf Interstate's 30-in. line, will be a 3500-hp, four-cycle, turbo-charged, vertical gas engine, driving a centrifugal compressor through a speed increaser. Gulf Interstate said that no other units of this type are being operated by any gas transmission company.

If it decides to use the equipment on a permanent basis, Gulf Interstate will request further certificate authorization prior to the termination of the test period. If the experiment proves successful, the company said, approximately $450,000 out of the total estimated original cost of $730,000 could be salvaged.

Government grants permit extension to Trans-Canada

Extensions of its permits to finance construction and export natural gas from Alberta have been granted Trans-Canada Pipe Lines Ltd. by the Alberta Petroleum and Natural Gas Conservation Board.

Trans-Canada had asked for the extensions in view of its inability to complete financing of the $350 million project by April 30.

Under the extensions granted, arrangements for financing the construction of the project must be completed by October 31; construction of the 2250-mile pipeline is to begin no later than June 30, 1956; and removal of natural gas from the province shall be on or before Dec. 31, 1956.

Practically all of the engineering work for the construction of the first section of the line from Alberta to Winnipeg and south to Emerson, Manitoba, has been completed, according to Trans-Canada.

In addition to the completion of the engineering work on the Alberta-Manitoba section of the line, final maps for submission to the Board of Transport Commissioners for this section of the line are 95% completed.

All necessary permit drawings are completed, and 75% of the construction permits have been received. Ap-

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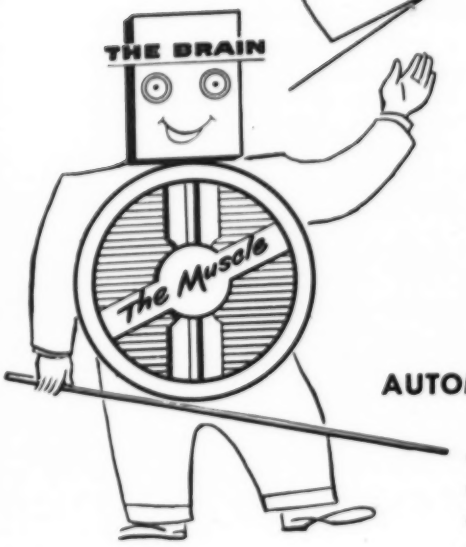

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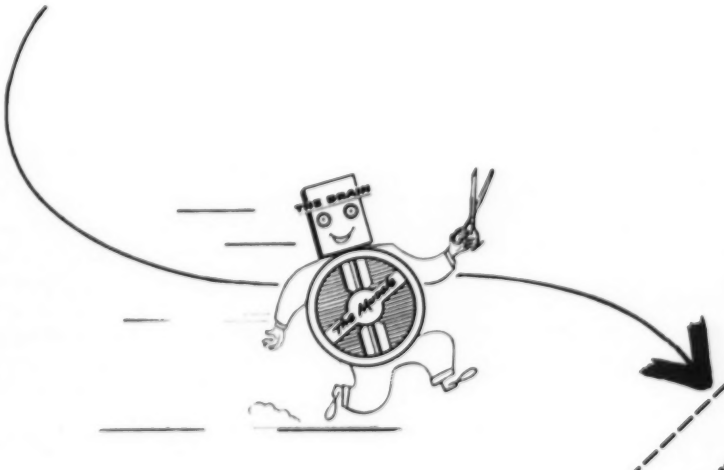

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proximately 82% of the right-of-way options have been acquired; general lay-out plans for gas compression facilities for the first year requirements are completed, and detailed drawings are well advanced.

On the central section of the line, between Winnipeg and Toronto, engineering work has proceeded to the point where 75% of the line location is ready for mapping. Also, 27% of these maps have been prepared and permit drawings are 27% completed. On the eastern section of the line, from Toronto to Montreal, final maps for the Board of Transport Commissioners are 77% comp.eted. Permit drawings are 74% completed, and about 65% of the right-of-way options have been obtained.

All pipeline construction specifications have been completed.

A total of $12,055,896 has been spent on the $350 million project to date. Of this sum, $5,335,000 was spent by Trans-Canada's subsidiary, Western Pipe Lines, in building the Niagara-Toronto line, which now serves the Toronto area with American natural gas, and will do so until the main Trans-Canada line is built. The remaining $6,720,896 has been spent on engineering and other work relative to the overall construction program.

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New idea in centrifugal compressors hold center of stage at pipeline meet

By **FRANK CHAPMAN** • Editor - Manager

New gas pipeline construction projects and facilities occupied the interest of those attending the annual AGA gas supply, transmission and storage conference last month in Pittsburgh. With the word out on extensive new pipeline construction to get under way this spring, there was more than average interest in new design features under consideration.

Although new construction already under way caused some to be absent from the meeting that would have ordinarily attended, registration slightly exceeded the 500 mark.

Centrifugal compressors driven by both turbines and internal combustion engines were the subject of formal and informal sessions. A supercharged gas engine driving a centrifugal compressor through a step-up gear was described by D. M. Salls of the Cooper-Bessemer Corp. This is the first of its kind to be built and it is to be put into operations this fall on one of the major cross country gas pipelines.

The engine is a Cooper-Bessemer LSV-16 rated at 3700 bhp at 327 rpm. The maximum speed of the engine is 360 rpm, which is 10% over noraml speed, at which the compressor load can be as high as 4500 bhp. The fuel consumption of the engine at full load is 6200 Btu per bhp per hr.

The unit requires a two-stage speed increaser drive as the compressor is rated at 5500 rpm at normal speed. The centrifugal compressor is the Cooper-Bessemer type RFB-24. It is a single stage unit.

A general discussion of the subject of prime movers for gas pipeline compressors was undertaken by R. A. Daugherty, Fish Engineering Corp. He traced the history of the gas engine-driven compressor from the 1880's to and including the modern turbine and internal combusion engine-driven centrifugals.

The current status of the General Electric gas turbine as a prime mover for high speed centrifugals was outlined by J. S. Quill, industrial engineering section, the General Electric Co. He pointed out that although "the first installation in the gas industry was made in 1952, by 1954 it accounted for half the total horsepower installed." He told of 210,000 hp installed on gas pipelines and 60,000 hp installed in gas repressuring service.

A discussion of gas dispatching problems encountered in the operation of gas turbines and centrifugal compressors as experienced by El Paso Natural Gas Co. was given by H. B. Lafferty, the company's chief dispatcher. He pointed out that the dispatcher has 25% or more horsepower available with the turbine-driven compressor with which to meet peak load conditions. Also the variable speed of the turbine-driven centrifugal provides a wide operating range without any mechanical adjustment. In addition the speed of response of the turbine stations in being able to pick up a load is advantageous to the dispatcher.

Its principal disadvantages, he said, were the surge characteristics of centrifugal and its inability to pack the line conveniently and without close coordination. The latter is not the case with all centrifugal compressors.

It was also brought out at the conference that Trunkline Gas Co. is installing the first two-stage centrifugal to be put into service on a gas pipeline that is designed for series or parallel operation. The compressor will be drivn by a 6700-hp gas turbine. The main gas piping and valving is arranged so that the two stages in a common compressor case can be operated either in series or parallel as flow conditions and pressure ratios require.

It was also brought out that two Westinghouse gas turbines are soon to be installed on one of the major gas pipelines driving centrifugal compressors. It is estimated that these units will be in operation in the fall of this year.

Along with the discussions of new compressor facilities on the pipelines contemplated and under construction were discussions of other facilities and construction techniques. Among these was the new 700-mile microwave system to be installed this summer by Texas Gas Transmission Corp.

Others were a discussion of particle matter removal, purification and dehydration of gas in a pipeline by A. L. Kohl and F. C. Riensenfeld of the Fluor Corp.; pressure pulsation tests of branch connections to large diameter pipe by A. R. C. Markl, H. H. George, and E. C. Rodabaugh all of Tube Turns; and the internal cleaning of pipelines with detergents by Clinton McClure, of the El Paso Natural Gas Co.

In his discussion of pipeline cleaning, Mr. McClure outlined a complete procedure for the cleaning of a pipeline section including the equipment design and cost figures for the operation.

Considerable emphasis was also placed upon the development and application of various types of underground storage.

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Producers authorized to sell to American Louisiana

Four independent producers have been authorized to sell gas to American Louisiana Pipe Line Co. (Dockets G-6067 et al) for transportation through its proposed Louisiana-to-Michigan line.

Although American Louisiana's project was authorized last October, it was conditioned to provide that construction couldn't start until the independents had applied for and obtained FPC certificates.

The commission said that American Louisiana offered proof that the four producers—Superior Oil Co., Kerr-McGee Oil Industries, Stanolind Oil & Gas Co., and British American Oil Producing Co.—together with a supply of gas to be received from Texas Gas Transmission Corp., have sufficient reserves to meet the requirements of the certificate.

Chairman Kuykendall filed a concurring statement in which he said that while he agreed that the four producers are entitled to certificates, he felt that the evidence presented by American Louisiana should have been offered in the dockets involving its own application and that of Texas Gas. He said he feared that the parties in those two proceedings have been deprived of due process of law, inasmuch as they have not been afforded an opportunity to examine American Louisiana's witnesses to offer evidence in refutation of such witnesses.

Trunkline Gas would build eight new compressors

Trunkline Gas Co., Houston, has applied to the FPC (Docket G-8664) for authority to construct eight new compressor stations totaling 56,000 hp along the route of its system in Texas, Louisiana, Mississippi, Tennessee, and Illinois, and 24 miles of line paralleling sections of its existing system in Texas to increase its sales of gas to Panhandle Eastern Pipe Line Co.

At the same time, Panhandle filed an application (Docket G-8665) for authority to add 16,000 hp compressor capacity at three existing stations to take the gas from Trunkline.

Trunkline would spend approximately $18.7 million, including about $1 million on gathering facilities; Panhandle's expenditures would approximate $3,714,000.

Plastic pipe for salt water disposal tested

Salt water presents a problem for flow lines in producing gas and oil fields because it produces internal and external corrosion in steel pipe. In addition, it may deposit considerable scale build-up, which effectively reduces the cross-sectional area of the conduit and retricts volume rate of flow. Heavy maintenance costs result from these factors, yet there is the ever present need for disposal of the salt water.

Union Producing Co., a subsidiary of United Gas Corp., Shreveport, La., has turned to plastic pipe for salt water flow lines in an effort to evaluate its ability to materially reduce the maintenance costs associated with steel pipe for this purpose. They recently laid 7300 ft of clear plastic pipe to dispose of salt water produced from one of their wells in the Holly Ridge field, Tensas parish, La. Approximately a mile and a quarter of 3.5-in. OD butyrate plastic pipe connects a producing well with a salt water disposal well. The pipe has a rated working pressure of 100 psig at 90° F and weighs slightly in excess of 1 lb per linear ft. Six men, using a pipe stringing truck, completed the laying of this field pipeline in one day's time. Three-man teams produced a finished joint between two

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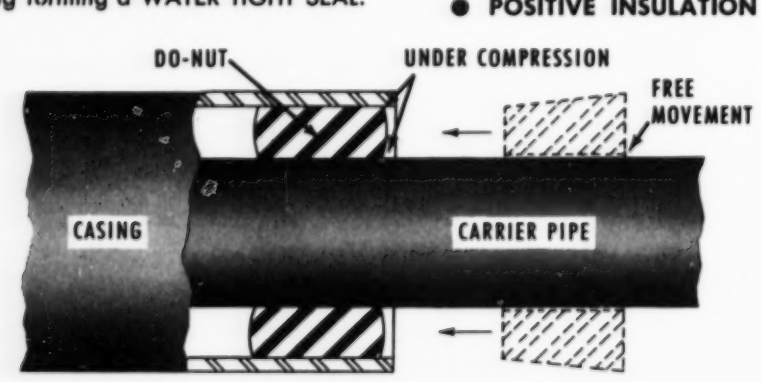

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of the 20-ft lengths of pipe in a very few minutes; construction practice used was to line up the extremely light pipe, apply primer and a solvent-type "welding" solution, and then stab the two joints of pipe together.

The complete transparency of the plastic material will allow the flow stream and the inner surface of the pipe to be visually inspected for corrosion and scale build-up. This is an experimental application: the gas industry knows what salt water will do to ferrous pipe, and this project has been undertaken to determine its effect, if any, on plastic pipe.

California companies seek 450 MMcf from El Paso

The recent agreement among Pacific Northwest Pipeline Corp., Westcoast Transmission Co., and El Paso Natural Gas Co., which are interested in the expansion of natural gas pipelines into the dynamic Pacific Northwest portion of the United States, has resulted in the announcement of impending increased deliveries of natural gas to California. This most recent result of the tremendous Pacific Northwest deal is the proposed delivery of 450 MMcf/day to Topock, on the California-Arizona border, from the San Juan and Permian basins through the San Juan pipeline system of lE Paso.

At Topock, where a 1760-hp compressor will be installed, the new out-of-state gas volume will be split; 225 MMcf/day will be available to Southern Counties and Southern California Gas Co.s, and an equal volume will be delivered to Pacific Gas & Electric Co. for transmission through the existing 34-in. line to the northern California market. A new 30-in., $31 million pipeline will be constructed from Topock to near Newhall to complete delivery of the 225 MMcf/day to the distribution properties of SoCal and So-Counties. This line will be jointly owned by the latter two companies.

El Paso will be obliged to loop its entire northern line from the San Juan basin to Topock for delivery of the additional gas.

The 450 MMcf/day can be diverted from its originally intended market in the Pacific Northwest because Westcoast will import gas into that area from the Peace river (Canada) producing area. Thus, this volume can be allocated to the natural gas-hungry California markets. News of the deal was announced simultaneously by SoCal, SoCounties, PG&E, and El Paso Natural, following several months of negotiations.

F. M. Banks, president of SoCal, explained that on the basis of engineering projections of expected growth, the peak day gas supply from all sources would lag behind firm gas requirements during the next four years unless the new construction and delivery can be accomplished. He emphasized that the timetable for deliveries to the Southern companies has been coordinated with the growth forecasts; that is, deliveries will be increased by 50 MMcf/day by Nov. 1, 1956; 75 MMcf/day by Nov. 1, 1957; 25 MMcf/day by Jan. 1, 1958; and the final 75 MMcf/day by Jan. 1, 1959.

In addition, the southern California companies will increase their underground storage capacity by the development of new reservoirs and further exploitation of existing storage strata. The combination of the additional gas and the storage facilities will provide a comfortable margin for the Greater Los Angeles area through 1959, in the opinion of the officials of the companies involved. Further, the new Topock-to-Newhall line will provide a northern entrance for gas into the area, which will furnish additional assurance of continuity of gas supply since the existing lines enter the area from the south.

Letters of agreement have been

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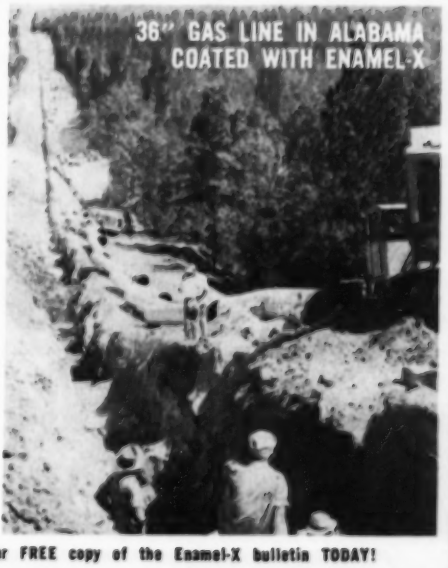

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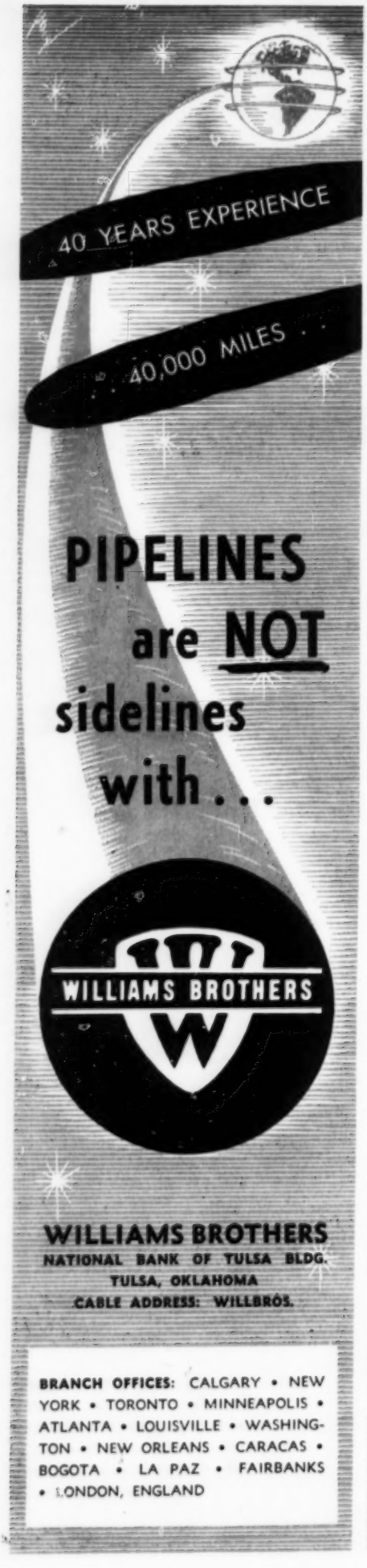
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pipeline news • *Cont'd.*

signed by the interested parties and it is planned that the proposals will be submitted to the FPC for authorization in mid-May. All of the plans are contingent upon the expected completion of Pacific Northwest's line. Pipe for this line is presently being rolled in western mills and there are no foreseeable blocks to its completion.

California's independent oil (and gas) producers have raised a howl over the new agreement. They are reported to feel that the entry of more out-of-state gas will further reduce the residual fuel oil market and produce an inequity in the prices paid for natural gas. The southern California companies will pay 27.75 cents/Mcf for the new gas as compared with 24.4 cents/Mcf paid for out-of-state gas at the present time. Mr. Banks pointed out that the present 18 cents/Mcf price paid California producers for gas comprising 35% of the demand is well above the national average paid producers and that there is little logic behind the California producers' suggestion that they should be paid the same price that will be paid El Paso for the out-of-state fuel. The amount that the California producers get is considerably higher than the amount that El Paso pays its out-of-state producers. California producers want to peg their prices at the same amount El Paso is paying at the border. If they had done it in 1954, it would have cost consumers $9 million.

The current agreement among SoCal, SoCounties, PG&E, and El Paso is but one of many business deals precipitated by the over-all Pacific Northwest plan. There will probably be more.

Panhandle's proposed abandonment ruled on

Proposals by Panhandle Eastern Pipe Line Co., Kansas City, Mo., to reduce natural gas deliveries to Michigan Consolidated Gas Co., Detroit, and to cut off service entirely to the Gas Service Co., Kansas City, were dismissed in a decision filed by an FPC presiding examiner (Docket G-1116 et al).

Presiding Examiner Law at the same time authorized Panhandle to abandon immediately 1 MMcf per day of the 18 MMcf daily delivery to Texas Gas Transmission Co., Owensboro, Ky., with the remaining service to be ended not later than next Jan. 1. Texas Gas recently was authorized by the FPC to construct new facilities to serve Indiana Gas & Water Co., Indianapolis, an existing customer, without the use of any gas from Panhandle—with the authorization conditioned on Texas Gas withdrawing its objection to Panhandle's proposed abandonment of service.

The decision also authorizes and directs Panhandle to supply natural gas to the city of Auburn, Ill., with deliveries limited to a maximum of 500 Mcf per day until next Jan. 1, or earlier if Texas Gas completes its project prior to that time. After that time, Auburn will get its full request of 1 MMcf daily.

In a similar ruling, Presiding Examiner Law made permanent an interim order issued last Dec. 14—subsequently affirmed by the commission—directing Panhandle to establish a connection with facilities to be built by Northern Indiana Fuel & Light Co., Auburn, Ind. In this case, deliveries are limited to 1.5 MMcf per day until Texas Gas completes its project, with the maximum then increasing to 4 MMcf daily.

Presiding Examiner Law's decision provides that deliveries to the Louisburg (Kan.) Gas Co. shall be limited to 550 Mcf per day, with volumes delivered to Central West Utility Co., Gas Service, and Missouri Power & Light Co. not to exceed those delivered to them on Jan. 21, 1954.

Subsequent to the issuance of the interim decision, Panhandle received temporary authorization from the FPC to operate facilities to deliver an additional 100 MMcf of gas per day. Presiding Examiner Law found that since that time, Panhandle appears to have been able to meet all demands of its mainline customers, and that there apparently is no present need for allocation of the company's gas supply, except on the Liberty lateral.

Financing arrangements made by Pacific Northwest

Financial arrangements for the construction of the 1466-mile line that will bring natural gas to the Northwest area have been completed.

The contruction program on Pacific Northwest Pipeline Corp.'s line called for laying 40 miles of pipe in April, 125 miles in May, and a fast schedule of work until the job is completed.

An underwriting group headed by White, Weld & Co.; Kidder, Peabody & Co.; the Dominion Securities Corp., and Union Securities Corp., is making the public offering of unit securities for Pacific.

Each unit, offered at a price of $72, consists of one 5½% interim note ($60 principal amount) and one share of common stock ($1 par value). This part of the financing comprises a total of $17,220,000 of 5½% interim notes due June 1, 1957, and 287,000 shares of common stock, and involves an aggregate public offering price of $20,664,000.

The company has entered into agreements with institutional investors providing for the issuance of $93.2 million

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Cold expanded, electric-fusion-weld line pipe meeting API 5LX specifications, in diameters from 18 in. to 36 in. Available in 40-ft lengths and in wall thicknesses to ⅝ in. Bethlehem is also equipped to coat pipe exteriors and interiors.

HIGH-STRENGTH PIPE

Pipe fabricated from alloy steels such as high-strength, low-alloy Bethlehem Mayari R steel plate (50,000 yield). This pipe is immediately available as rolled in 40-ft lengths and in wall thicknesses as required. All diameters from 18 in.

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You can save the cost of an auxiliary engine and the time lost in loading or towing it by putting a 4-wheel-drive Universal 'Jeep' on the job. With power take-off, the 'Jeep' operates air compressors for pneumatic tools as shown above, electric power generators and other belt-driven equipment. See your nearest Willys dealer or write for information.

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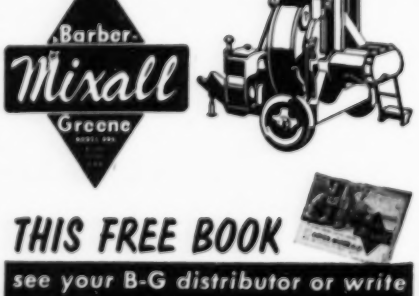

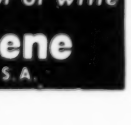

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pipeline news • *Cont'd.*

of first mortgage pipeline bonds 4¼% series due 1975. The balance of the financial program includes agreements providing for the issuance of $26.8 million of 3½% unsecured notes to banks due serially from 1958 to 1962, and the issuance of an aggregate of $6,329,000 in payment of part of the cost of oil and gas leases being acquired by Pacific Northwest.

Kansas commission fears unbalanced withdrawals

Ten major gas producing companies have been challenged by the Kansas corporation commission for allegedly taking more gas from the Hugoton field in Oklahoma and less from Kansas.

The commission fears unbalanced drainage of the field because of larger withdrawals from Oklahoma and Texas Panhandle sides of the field.

Companies challenged are Cities Service Gas Co., Colorado Interstate Gas Co., Hugoton Production Co., Kansas-Colorado Utilities Inc., Kansas-Nebraska Natural Gas Co., Northern Natural Gas Co., Panhandle Eastern Pipe Line Co., Quinque Oil & Gas Producing Co., United Carbon Co., and Century Refining Co.

GAS pipeline notes

Westcoast Transmission Co. Ltd., Calgary, has been authorized to increase its rate of gas export from Alberta's Peace river area to 56 billion cu ft yearly, with a maximum rate of 190 MMcf daily and a total of 1.8 trillion cu ft over a 20-year period. The company will get the rest of its gas export needs from British Columbia.

W. F. Davey, president of Winnipeg (Manitoba) & Central Gas Co. is considering asking the Alberta Conservation Board and the Board of Transport Commissioners for the right to build a pipeline from Alberta to Winnipeg.

T. D. Williamson Inc., Tulsa manufacturer of specialized equipment for pipeline maintenance and construction, has appointed Alfred Kent of Alfred Kent & Son as its new California representative.

Transcontinental Gas Pipe Line Corp., Houston, has received special tax benefits for a $69,497,703 project to supplement its system, the Office of Defense Mobilization has announced. Transco will write off one-quarter of its estimated costs against its taxes over the next five years.

Atlantic Seaboard Corp., Charleston, W. Va., has been authorized (Docket G-6500) to construct an 84-mile, 26-in. line paralleling sections of its existing Cobb (W. Va.) to Baltimore pipeline at various points in West Virginia and Maryland. Two thousand hp will be added at the company's Cleveland compressor station.

During the closing days of the legislative sessions, bills were passed in Alaska and Utah defining and prohibiting the waste of oil and gas. The bill in Alaska provides for the establishment of an Alaska Oil and Gas Conservation Commission. In Utah, the Utah State Land Board is designated as the oil and gas conservation commission.

GAS progress reports

NEW CONSTRUCTION PLANNED

NORTHERN NATURAL GAS CO., Omaha. Docket G-2460 28.4-mile 30-in. line from Ogden compressor station to gas reservoir near Redfield, Iowa.

CURRENT CONSTRUCTION

ARKANSAS LOUISIANA GAS CO., Shreveport. Docket G-2307 for 134 miles of 6⅝- to 24-in. line in 11 sections, and 10,500-hp compressor station on its system in Arkansas, Louisiana, and Texas. Compressor station and 71 miles of line completed.

EAST OHIO GAS CO., Cleveland. A 113-mile, 30-in. pipeline to serve Cleveland area from point just south of Toledo. Construction started April 15.

EL PASO (TEXAS) NATURAL GAS CO. Docket G-2106 and G-2462 for 74 miles of line and 6925 additional hp on system in Texas, New Mexico, and Arizona. Should be completed by July 1.

MANUFACTURERS LIGHT & HEAT CO., Pittsburgh. Docket G-2193 for 72 miles of 20- and 16-in. line, 38.7 miles of storage and well lines, 2 measuring stations and a 1760-hp compressor station at the Victory storage field in Marshall and Wetzel counties, W. Va.

MANUFACTURERS LIGHT & HEAT CO., Pittsburgh. Docket G-2289 for construction of 75½ miles of 10-, 12-, 24-, and 26-in. lines and 4400 in new and additional compressor facilities in Washington, Allegheny, Chester, Lancaster, and Adams counties, Pa., and Marshall county, W. Va.

MANUFACTURERS LIGHT & HEAT CO., Pittsburgh. Docket G-2479 for 61 miles of line and 1760 hp in compressor capacity on its system in Ohio, Pennsylvania, and West Virginia.

NATURAL GAS PRODUCERS INC., Colorado Springs. To construct 48.7 miles of 10-in. from northeastern Colorado gas fields to Colorado Interstate's 20-in. line and 3 miles of 8-in. and 14 miles of 4-in. line to connect Adena field with Fort Morgan. R. H. Fulton & Co. about 40% completed; balance about June 10.

PACIFIC GAS & ELECTRIC CO., San Francisco. An 18-mile, 12-in. line in Colusa and Glenn counties to bring gas into Sacramento valley from two new fields. September completion.

PANHANDLE EASTERN PIPE LINE CO., Kansas City, Mo. Docket G-2433 for 575 miles of new line (294.6 miles approved), mainline loops, storage, lateral and gathering lines in Kansas, Missouri, Illinois, Indiana, Ohio, and Michigan and 113,000 hp in additional compression. Also

4-wheel drive does another job better!

TRANSPORTING WORKERS

Wherever the job may be, the 'Jeep' Truck gets there with men and equipment. With the extra traction of its 4-wheel drive, it goes through sand, mud, snow and roadless fields . . . up steep hills and other places ordinary vehicles can't go. On good roads it shifts easily to 2-wheel drive for conventional driving. See your nearest Willys dealer or write for information.

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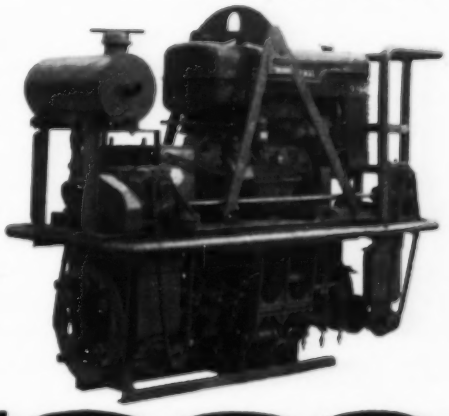
CROSE LINE TRAVELING PIPE CLEANING AND PRIMING MACHINE

This versatile pipe cleaning and priming machine can be used for line traveling operation or with stationary base (shown at right) for yard cleaning and priming—either way it is better built and more efficient to give you faster, trouble-free service. Crose cleaning and priming machines are available for all sizes of pipe including 36"



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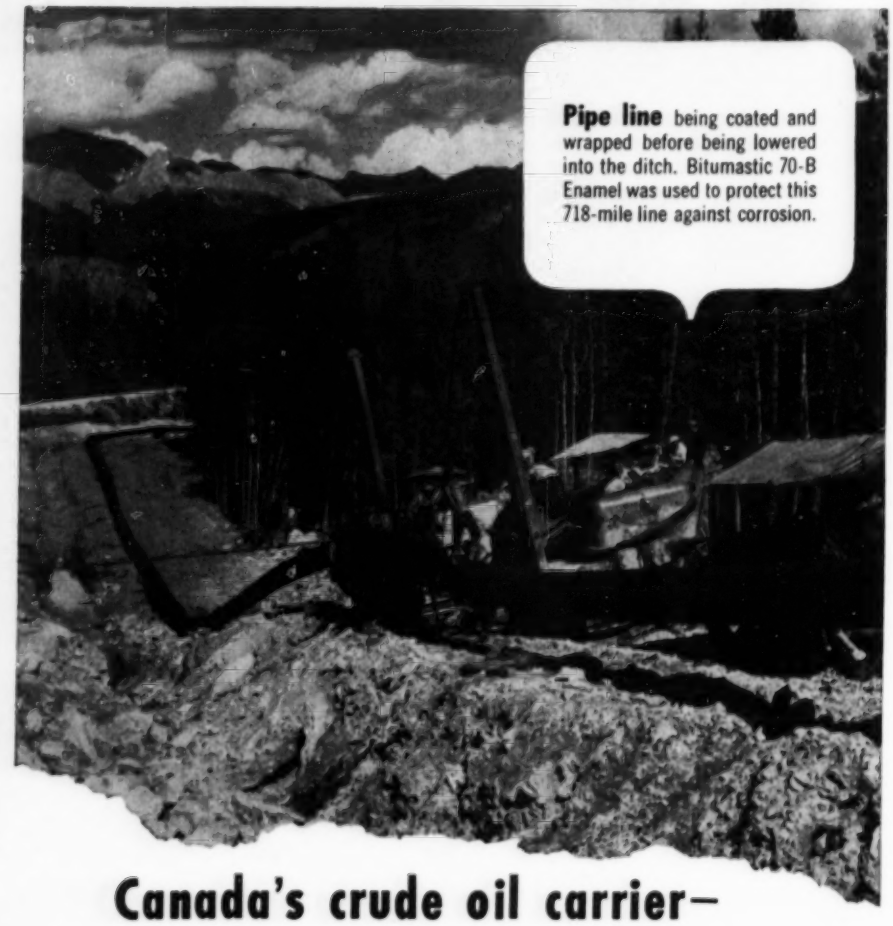

Pipe line being coated and wrapped before being lowered into the ditch. Bitumastic 70-B Enamel was used to protect this 718-mile line against corrosion.

Canada's crude oil carrier—

Trans Mountain Oil Pipe Line

—protected by Bitumastic 70-B Enamel

A river of oil now rolls all the way from Edmonton, Alberta, to Vancouver, British Columbia—a distance of 718 miles. Each day, more than 100,000 barrels of crude oil can be pumped through the Trans Mountain Oil Pipe Line that was recently completed.

Building this new 24-inch pipe line wasn't easy. Mountains had to be climbed. Rivers had to be forded —forded, at times, by using sealed sections of pipe as pontoons for temporary bridges. In some mountainous terrain, after using trucks, tractors and winches, pipe had to be carried into position, piece by piece.

A pipe line laid in such rough terrain deserves exceptional protection against corrosion. Recognizing this, Trans Mountain has coated the exterior surfaces of its new line, all 718 miles of it—with Bitumastic® 70-B Enamel. More than 20 years of satisfactory service protecting oil and gas pipe lines prove that Bitumastic 70-B Enamel is an excellent corrosion barrier.

For your next pipe-line project, specify Bitumastic Enamel. Get in touch with us for complete details and estimates.

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includes development of Waverly storage field in Morgan county, Ill. Will increase peak-day delivery capacity from 970 to 1425 MMcf daily. Approved portion virtually completed. Balance awaits FPC approval.

SHENANDOAH GAS CO., Lynchburg, Va. Docket G-1448 for 39 miles of line from a point near Middletown, Va. to points near Winchester, Va. and Martinsburg, W. Va. Somerville Construction Co. scheduled to complete line this month.

SOUTH GEORGIA NATURAL GAS CO., Birmingham, Ala. Docket G-1915 for 368-mile, 12¾-in. line beginning at connection with Southern Natural line in Lee county, Ala., extending southeast to serve new communities in Georgia and Florida. Expected completion date: September 1955.

SOUTHEAST ALABAMA GAS DIST., Birmingham. A "U" shaped system of about 330 miles to serve 24 communities in southeastern Alabama from connections with Southern Natural. About 65% completed. Scheduled for completion in September.

TENNESSEE GAS TRANSMISSION CO., Houston. Dockets G-2310, G-2330 and G-2331. Construction has begun in Pennsylvania on a 243- mile, 24-in. line from Hebron (Pa.) storage field to Greenwich, Conn., and on an 18-mile 24-in. Hebron to Harrison storage field. Development of two more storage fields—Colden near Buffalo; Harrison, in Potter county, Pa. Construction is underway at Isola, Miss., and at Morhead, Ky. on new compressor stations. Application granted by FPC for 370-mile, 30-in. line from Agua Dulce, Texas, to Kinder, La., along Texas and Louisiana Gulf Coast line will be in lieu of authorized facilities not yet built along main system in Texas and Louisiana.

TEXAS EASTERN TRANSMISSION CORP., Shreveport, and **NEW YORK STATE NATURAL GAS CORP.**, Pittsburgh. Docket G-2784 to construct field pipelines to connect up additional wells in Murrysville pool; acquire 2000-hp field gathering compressor station; and install 1980-hp station. New York State will operate facilities.

APPROVED

MICHIGAN GAS STORAGE CO., Jackson. Docket G-6501 for 36-mile 16-in. line and 3300 hp addition at Freedom compressor station in Michigan. Line would extend from Mt. Pleasant Junction to Milwaukee Junction.

ATLANTIC SEABOARD CORP., Charleston, W. Va. Docket G-6500 for 84-mile, 26-in. line paralleling Cobb (W. Va.)-Baltimore (Md.) line in West Virginia, Virginia, and Maryland, and 2000 additional hp at Cleveland station in Upshur county, W. Va.

GAS pipeline people

BUEL M. WALLIS has been named general sales manager of Schield Bantam Co., Waverly, Iowa.

RICHARD I. WHELAN, formerly manager of oil country tubular sales, has been elected vice president of the Youngstown Steel Products Co. of California, Los Angeles.

L. L. ARMSTRONG, chief engineer, has been promoted to vice president in charge of operations of the Commonwealth Natural Gas Corp., Richmond, Va.

LOUIS C. ROVE has been appointed district manager of the Great Lakes territory of Nordberg Manufacturing Co. and WILLIAM C. YOUNG has been

transferred from that territory to industrial and petroleum sales.

Transcontinental Gas Pipe Line Corp. has established a customer service department to be headed by R. STEWART BRUNS JR., vice president. Transco has also announced that H. P. LINDEE is supervisor of the general accounting department and that C. G. CAMPBELL is assistant treasurer.

Foxboro Co. has appointed C. C. FULLER, vice president; H. O. EHRISMAN, general sales manager; and J. J. BURNETT, field sales manager.

Black, Sivalls & Bryson Inc., Kansas City, Mo., has announced several appointments. ANDY SHAW is in charge of a new branch office at Sherman, Texas; JOHN B. HUMPHREY JR. succeeds Mr. Shaw as branch manager at Oklahoma City; JOHN H. RAIDL is sales manager, West Coast district, in Los Angeles; LEE KELTON is manager of Mid-Continent oilfield sales; RALPH STEVENS is manager of Gulf Coast oilfield sales; BENJAMIN BOURNE is oilfield district sales manager in Houston; JOHN CROSS is oilfield district sales manager for the newly created Alice district; and JIMMY LEE is district sales manager for the newly created Salem oilfield district.

ARTHUR H. SISSON has been named manager of advance engineering of General Electric Co.'s small turbine and supercharger department. RICHARD A. BAKER succeeds Mr. Sisson as engineering administrator.

Tennessee Gas Transmission Co., Houston, has promoted JOHN TALBOT to compressor superintendent and GEORGE WHITE to assistant compressor superintendent.

Texas Gas Transmission Corp., Owensboro, Ky., has elected JOHN KIRTLEY vice president in charge of public and employee relations; W. L. STANTON vice president in charge of gas supply; W. M. ELMER senior vice president in charge of financing, sales, gas supply, production, and FPC regulation. V. W. MEYTHALER, formerly assistant treasurer, succeeds Mr. Elmer as treasurer. R. W. BRANDON is now assistant treasurer. DENNIS L. NEWBERRY, formerly division safety manager, has been appointed to the newly created position of sales representative in the company's sales and customer relations department.

A. E. HOHMAN, advertising manager of Blaw-Knox Co. since 1944, has been appointed coordinator of special sales activities. PAUL F. VOLLMER succeeds Mr. Hohman as advertising manager.

NEW 6 TON SELF-PROPELLED BANTAM!

* IT SELLS FOR ONLY $11,500

Look what you get in the new CR-35!

- Independent Travel, Forward & Reverse
- Turns INSIDE 40' Circle
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- Power Up & Down Boom Hoist
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- Works with 9 different Attachments!

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NO OTHER MACHINE of this size has ever offered so many time and money saving features! Lifting big loads . . . maneuvering in tight spots where other rigs can't go, the New BANTAM will let you realize greater speed and economy than you thought possible. You can't afford NOT to investigate the revolutionary New CR-35! WRITE TODAY.

CARRIER OR CRAWLER BANTAMS are outstanding performers, too! Mobile Carrier Bantam ideal for scattered assignments . . . travels up to 40 MPH! Crawler Bantam works in bad ground conditions where other rigs can't go . . . features 2-speed independent travel!

T-35A

C-35A

SCHIELD Bantam Co.

World's Largest Producers of Truck-Cranes and Excavators,

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